# Quelle consommation de sel idéale recommander dans une alimentation équilibrée?

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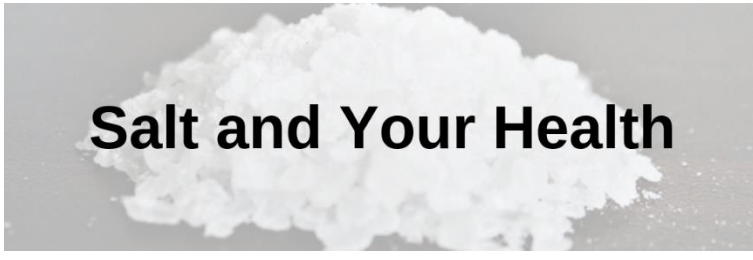
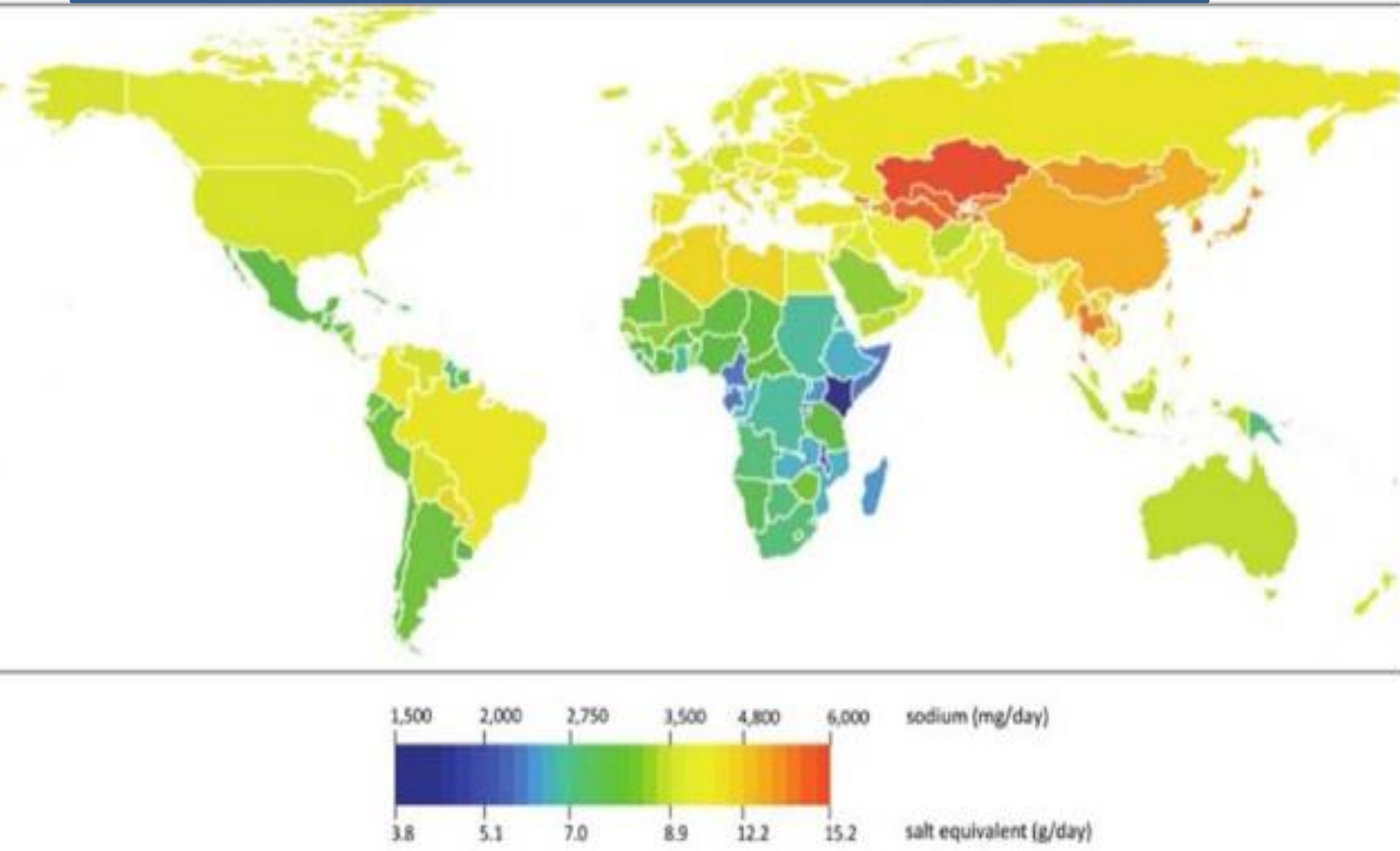


# Apport en sel, de quoi parle-t'on?

L'apport quotidien conseillé est de 5 g de sel (ou chlorure de sodium ou NaCl)

Soit 2 g ou 85 mmoles de sodium ($Na^+$)ou encore une cuillère à café de sel.

# Consommation sodée selon les pays en 2010




Mean global sodium intakes in 2010, by country worldwide (from Powles et al., 2013).

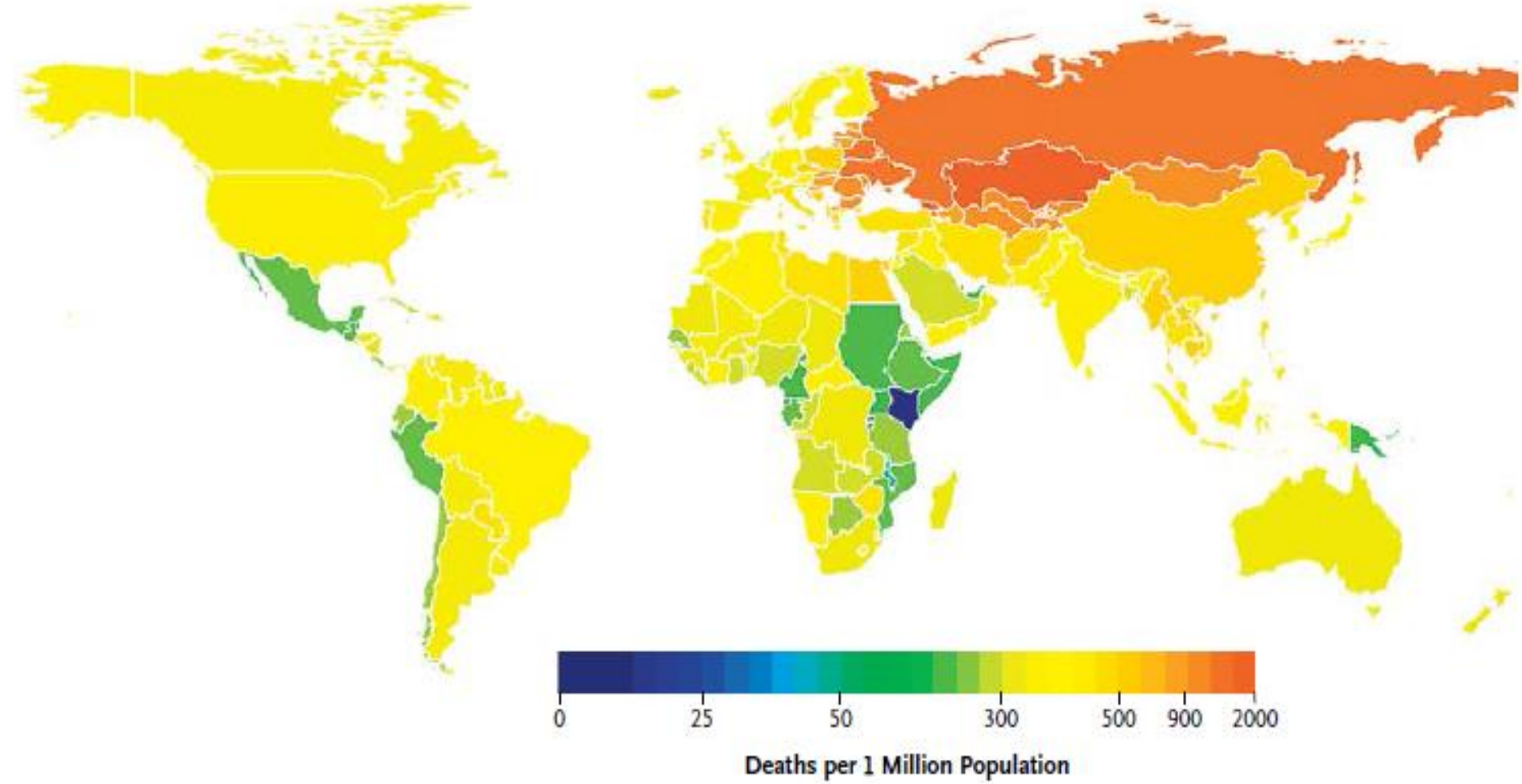
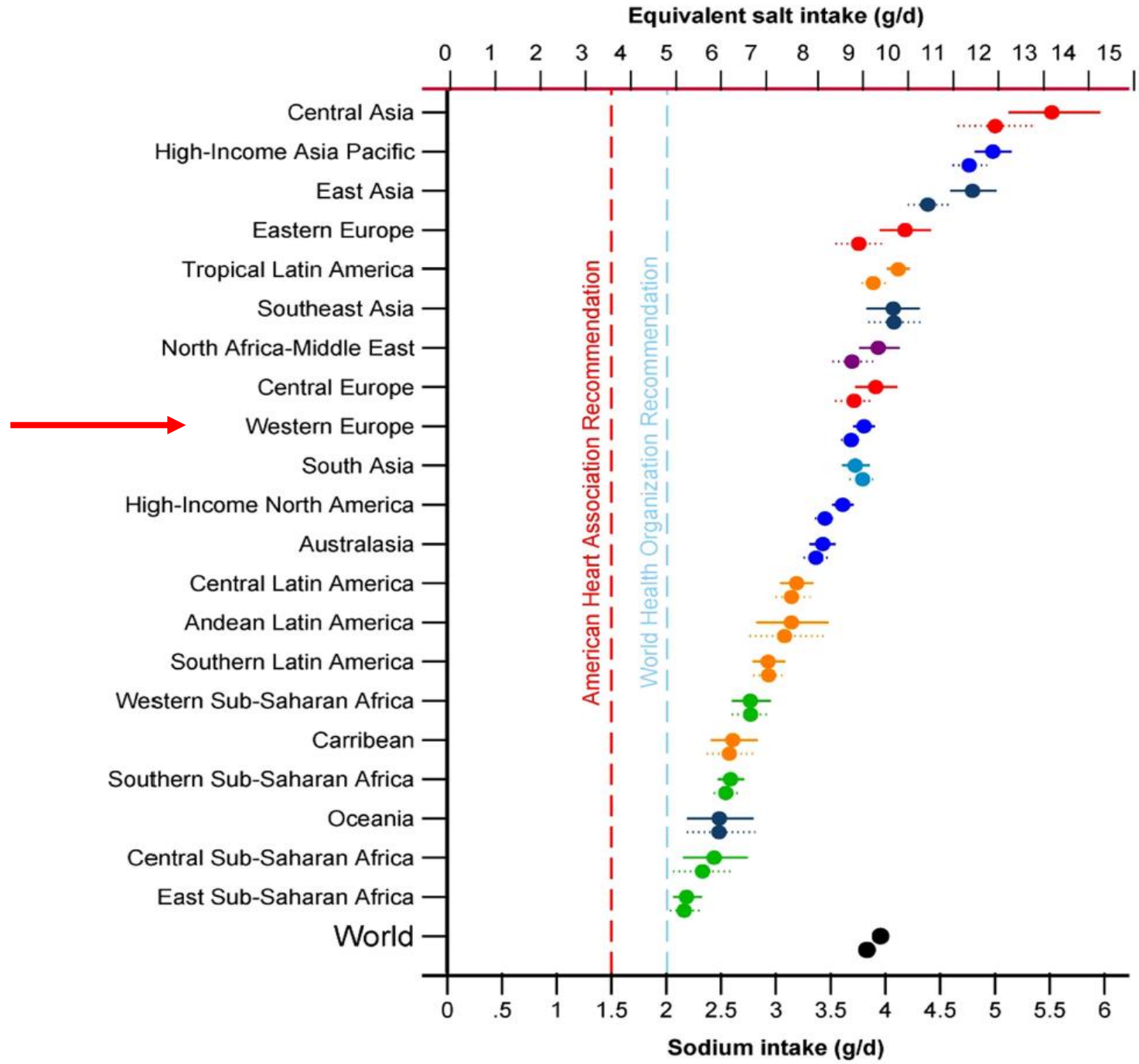



**Figure 3. Absolute Cardiovascular Mortality Attributed to Sodium Consumption of More than 2.0 g per Day in 2010, According to Nation.**
The scale is based on the number of deaths from cardiovascular causes (per 1 million persons) in 2010 that were attributed to sodium consumption of more than 2.0 g per day.




Mean (95% uncertainty interval) age-standardised sodium intakes (g/day) in 1990 and 2010

Powles J, Fahimi S, Micha R, *et al. BMJ Open* 2013;

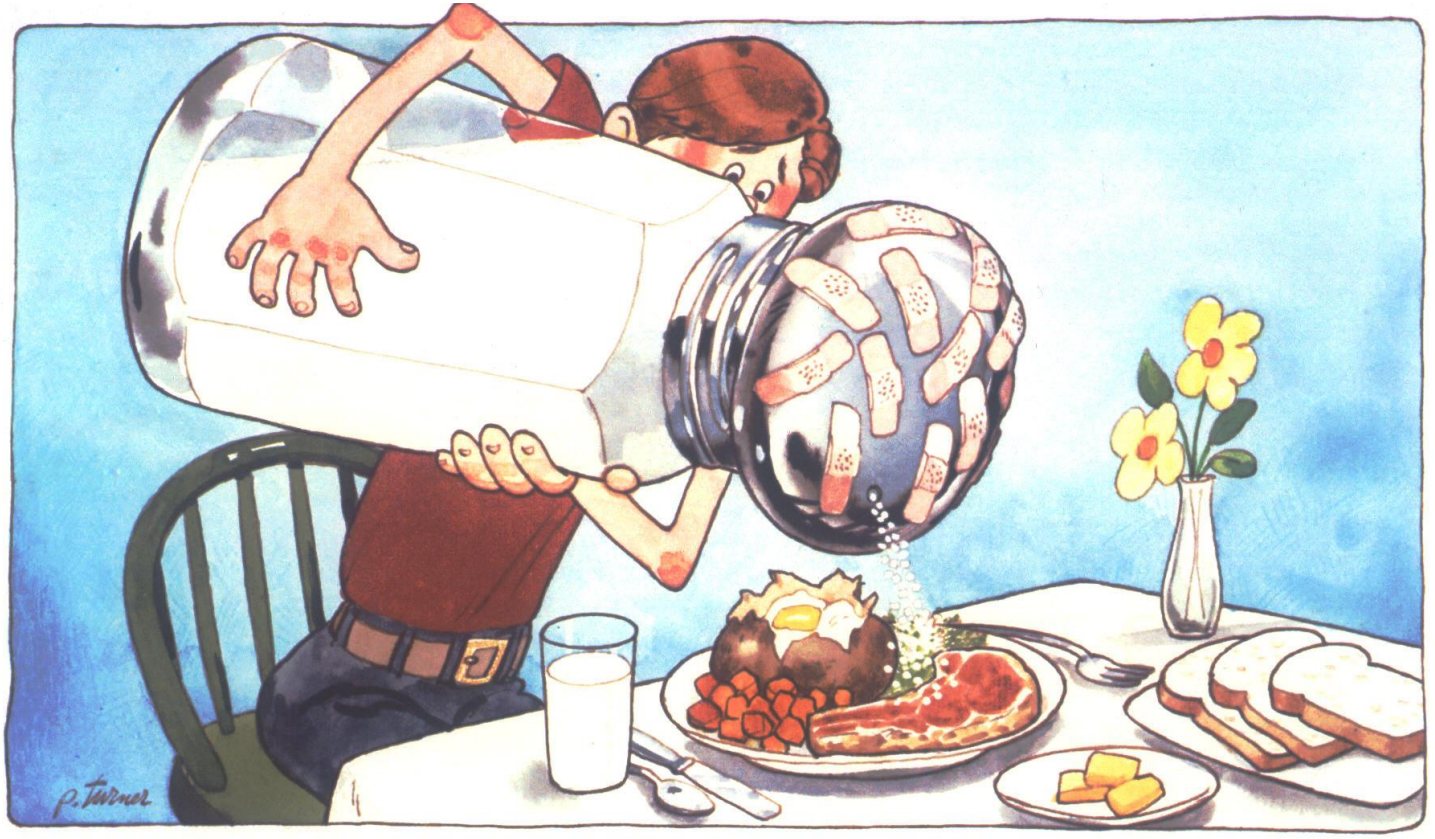
Conseil
Supérieur de la Santé

# RECOMMANDATIONS ALIMENTAIRES POUR LA POPULATION BELGE ADULTE - 2019

***Groupes alimentaires à limiter***

1. Viandes rouges transformées et volailles transformées
2. Viandes rouges, excepté les volailles
3. Boissons avec sucres ajoutés
4. Matières grasses riches en acides gras saturés athérogènes / acides gras trans
5. Produits sucrés
6. Produits salés

# Quelle quantité de sel proposer dans une alimentation équilibrée?




Reduce your sodium intake, and you'll soon find you crave less salt.

# Développement d'un intérêt pour le sel

- A l'âge de la pierre, consommation de NaCl: 700mg/j
- Depuis 10000 ans, utilisation pour la conservation des aliments (élément stratégique)
- Développement d'un commerce pour le sel (or blanc), qui devient le symbole d'amitié, de loyauté, d'hospitalité
- A l'époque romaine, consommation de 25g/j (préservation de la santé: salus, salubritas) et utilisation comme salaire (salarium, ration pour le sel)
- Au Moyen-Age, apparition en France d'une taxe royale sur le sel (Gabelle: 6% des revenus royaux) et apparition de la salière.

**Figure 1.** Salt cellar made of gold, enamel, and ebony by Benvenuto Cellini (1500 to 1571) and presented in 1543 as gift to Francois I, King of France (1494 to 1547). The salt cellar, valued at approximately US $55 million, was stolen in May 2003 from the Kunsthistorisches Museum, Vienna, Austria. It was recovered undamaged by the Austrian police in January 2006. (Photograph obtained from unrestricted web page of FBI Top Ten Art crimes. Available at: http://www.fbi.gov/hq/cid/arttheft/topten/cellini.htm. Accessed April 11, 2007.)

# Au contraire de l'ère ancienne, le sel ne fait pas du tout défaut dans l'alimentation d'aujourd'hui!

# Régulation de la balance sodée

- L'apport quotidien actuel en NaCl avoisine en moyenne les 8-9 g/j en Belgique mais cela peut varier de 2 à 25 g de NaCl/j)
- La majorité du sodium est éliminée par les reins.
- La quantification de l'apport sodé s'effectue, le plus précisément, sur base de **plusieurs** récoltes d'urines de 24h!

# Message is in the Measurement

*Hypertension*. 2019;74:505-506.

90% of Sodium intake excreted in urine, but with variability by day, hour, posture;

Accuracy of urinary sodium measurement in individuals constrained by logistics, costs, need for large number of samples [5]

| Sample Collection | Logistics | Costs | Accuracy | He et al.[4] analysis | Message | Conclusion |
|---|---|---|---|---|---|---|
| Spot urine  | Less complicated | low | Depends on formulas; formulas include factors which are themselves associated with mortality<br>Validation: conflicted | Intrinsic bias and distortion of sodium uptake – mortality relationship | J- or U- shaped relationship of sodium intake to mortality with notable increase in mortality at estimated low dietary sodium intake | Potential harm with population-wide sodium reduction, especially at lowest levels of dietary sodium intake<br>**Public policy** should recommend dietary sodium restriction only for populations at highest risk: persons with HBP, CVD, diabetes |
| 24 hour urine  | Complicated | high | Depends on engagement of subjects and completion of collection; requires multiple measurements separated in time; highly accurate when properly performed | Linear relationship of sodium intake to mortality | Linear relationship between sodium intake and mortality, across wide range of dietary sodium intake | Dietary sodium restriction reduces cardiovascular morbidity across wide range of baseline dietary sodium intake<br>**Public policy** should Recommend population-wide reduction in dietary sodium with ideal goal of about 1500 mg sodium |

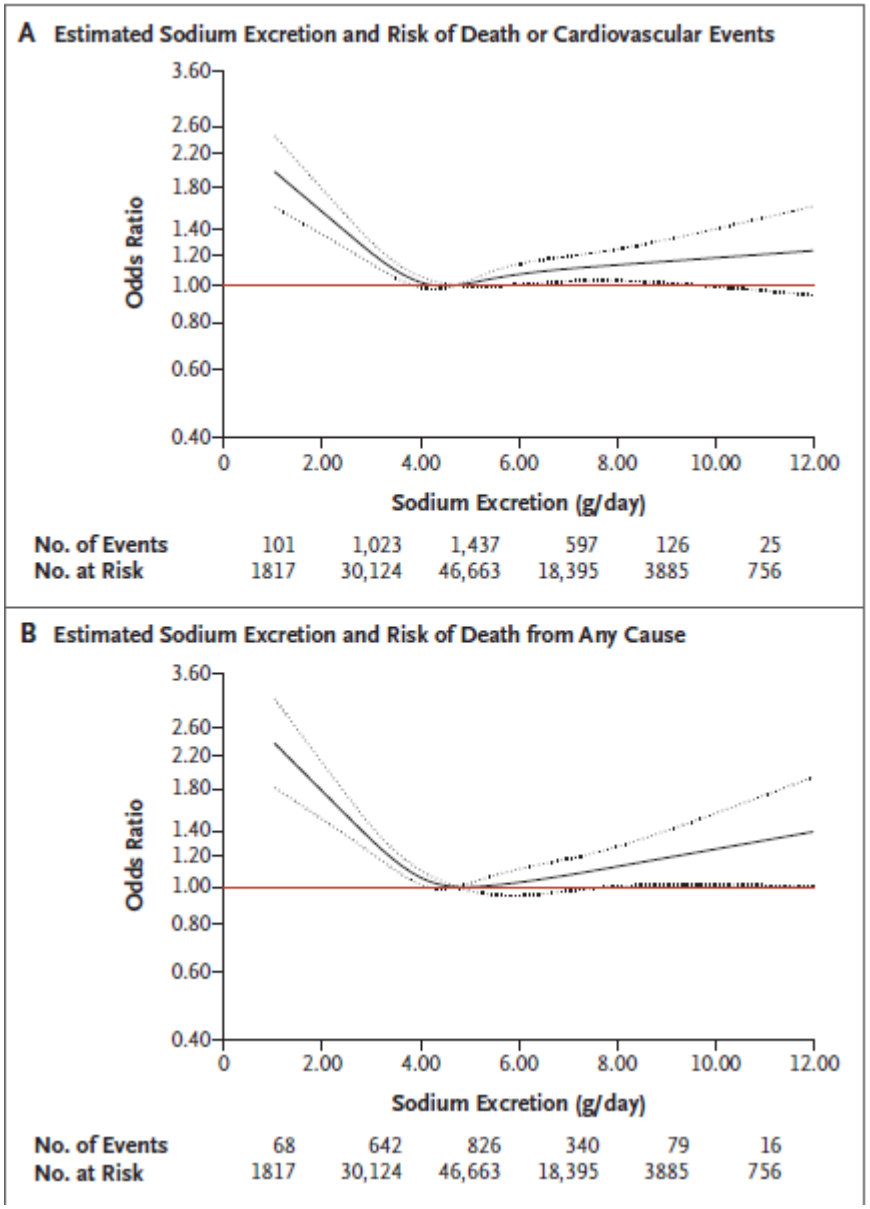



**Figure 1. Association of Estimated 24-Hour Urinary Sodium Excretion with Risk of Death and Major Cardiovascular Events.**

# Assessing whether a spot urine specimen can predict 24-h urinary sodium excretion accurately: a validation study

**TABLE 3. Comparison of estimated 24-h urinary sodium excretion from published equations[a]**

| Equation | 24-h USE (mean ± SD) (mg/day) | $r_s$ | *P* value[b] | Mean difference[c] (95% CI) (mg/day) | RMS |
|---|---|---|---|---|---|
| Measured value | 4558.25 ± 1908.75 | Reference | Reference | Reference | Reference |
| Kawasaki | 5326.52 ± 1556.29[d] | 0.332 | 0.002 | 768.26 (315.31–1221.22) | 5.46 |
| INTERSALT | 3138.86 ± 688.00[d] | 0.352 | 0.001 | −1419.39 (−1794.85 to −1043.93) | 5.48 |
| Tanaka | 4460.33 ± 1154.00 | 0.525 | <0.001 | −97.92 (−469.19–273.34) | 3.25 |
| SunSMU | 3604.62 ± 900.10[d] | 0.257 | 0.017 | −953.63 (−1363.88 to −543.39) | 4.94 |
| SunPM | 4344.09 ± 1041.70 | 0.407 | <0.001 | −214.02 (−605.70 to 177.66) | 3.63 |

95% CI, 95% confidence interval; INTERSALT, International Cooperative Study on Salt, Other Factors, and Blood Pressure; $r_s$, Spearman correlation coefficient; RMS, residual mean square; SD, standard deviation; 24-h USE, 24-h urinary sodium excretion.
[a]Two participants did not void during afternoon periods, so the sample size of all equations was 85 except for the SunPM equation ($n = 83$).
[b]The significance test of correlation coefficient.
[c]Mean difference, estimated minus measured 24-h USE.
[d]Significantly different from measured 24-h USE assessed with Wilcoxon's Signed Rank test.

**Conclusion:** There is still no evidence to support that 24-h USE could be estimated accurately using the current equations, especially for the equations developed by casual spot urine specimens.

Journal of Hypertension 2018, 36:(

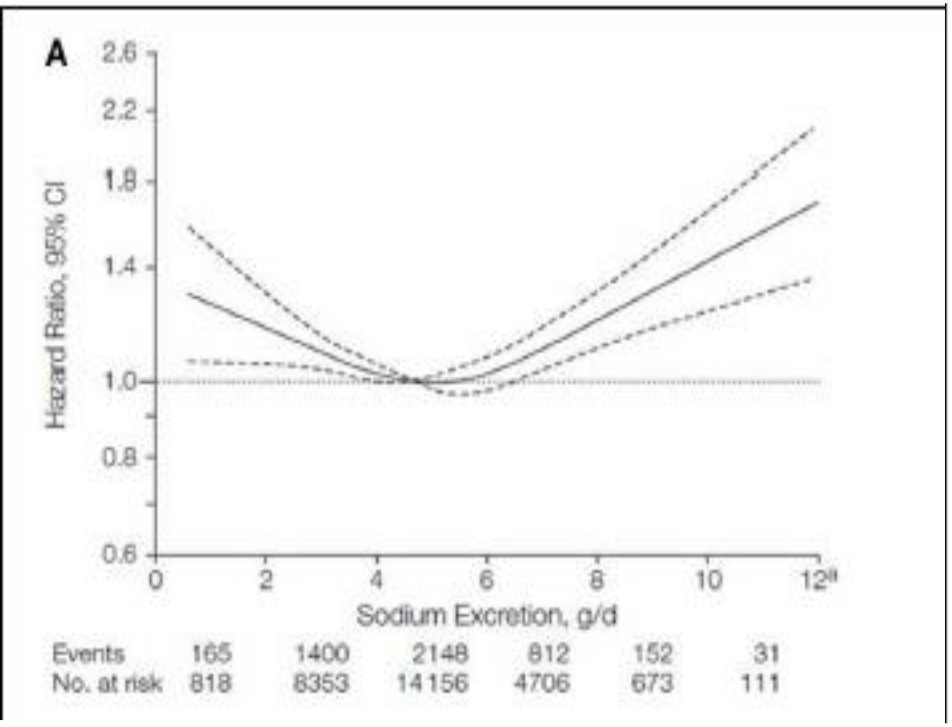
**Table 1. Total Mortality in the Trials of Hypertension Prevention Cohorts Post-Trial Follow-Up by Categories of Measured 24-h UNa Excretion Among Individuals Not in a Sodium Reduction Intervention**

| Variable | Measured Sodium Excretion (mg/24 h) | | | | *P* Trend | Hazard Ratios per 1000 mg/24 h | *P* Value |
|---|---|---|---|---|---|---|---|
| | <2300 | 2300–<3600 | 3600–<4800 | ≥4800 | | | |
| Average measured 24-h UNa | | | | | | | |
| Deaths/total (%) | 23/312 (7.4) | 105/1182 (8.9) | 93/979 (9.5) | 51/538 (9.5) | | | |
| Hazard ratios (95% CI) | 0.73 (0.45–1.20) | 0.94 (0.70–1.26) | 1 (reference) | 1.09 (0.76–1.55) | 0.204 | 1.12 (1.01–1.25) | 0.032 |
| First measured 24-h UNa | | | | | | | |
| Deaths/total (%) | 44/440 (10.0) | 71/811 (8.8) | 57/693 (8.2) | 68/716 (9.5) | | | |
| Hazard ratios (95% CI) | 1.23 (0.81–1.86) | 1.15 (0.80–1.64) | 1 (reference) | 1.20 (0.84–1.73) | 0.850 | 0.99 (0.91–1.06) | 0.703 |

From Cox proportional hazards regression models stratified by trial phase and adjusted for age, sex, race/ethnicity, clinic, treatment assignment, education status, baseline weight, alcohol use, smoking, exercise, and family history of cardiovascular disease. UNa indicates urinary sodium.

An accurate measurement of an individual's sodium intake is vital for epidemiological studies relating sodium intake to health outcome.[37] Twenty-four–hour UNa excretion is considered the gold standard method for assessing sodium intake. Despite this, 1 single 24-hour urine cannot be used to estimate an individual's usual intake because of the large day-to-day variations in sodium intake. To get a reasonably reliable estimate for an individual, a minimum of three 24-hour urine collections are needed.[38–40] TOHP collected three to seven 24-hour urines during a period of 18 months to 4 years and demonstrated a direct linear relationship between sodium intake and mortality. However, replacing the accurately

# Controverses quant à l'apport idéal en sel



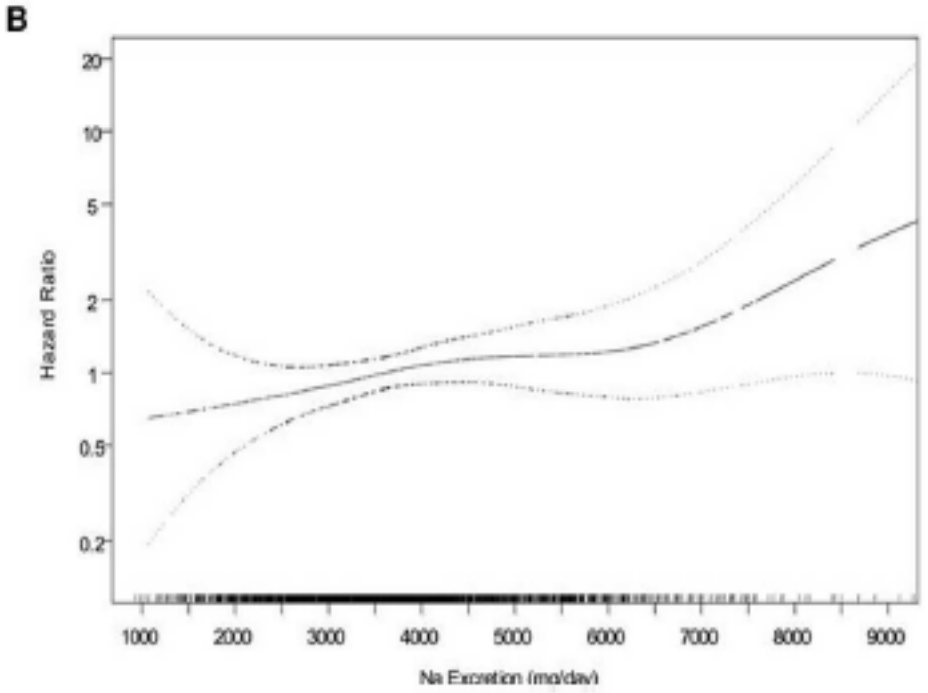
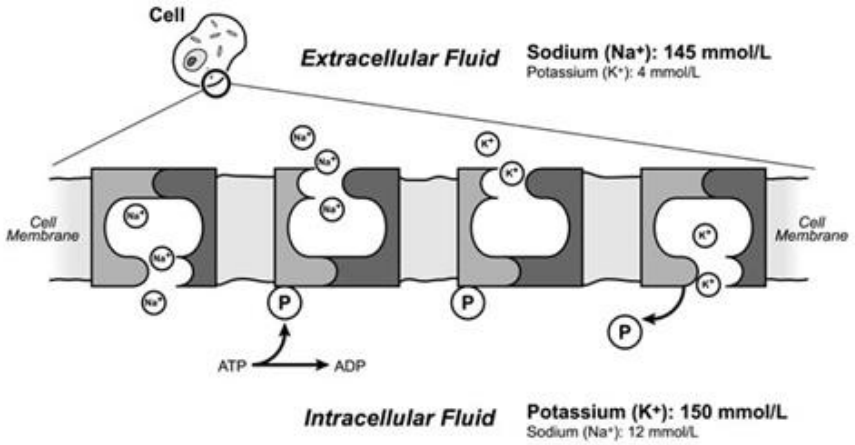



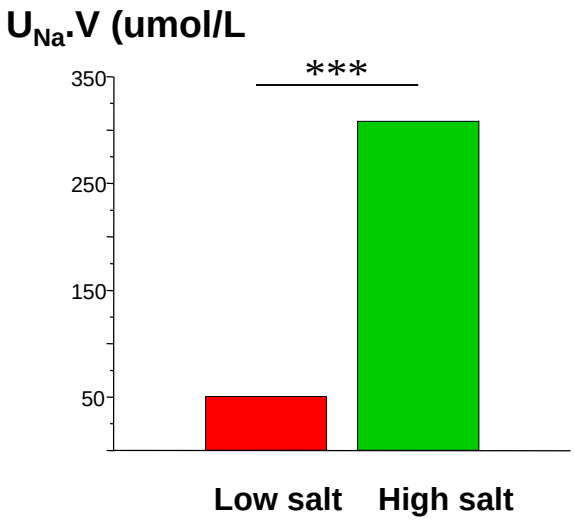

**FIGURE 3 | Relationship between urinary salt excretion and the hazard ratio for cardiovascular events or death according to O'Donnell (A) suggesting a U-shape curve and according to Cook RN suggesting a linear relationship (B) (from O'Donnell et al., 2011; Cook et al., 2014).**

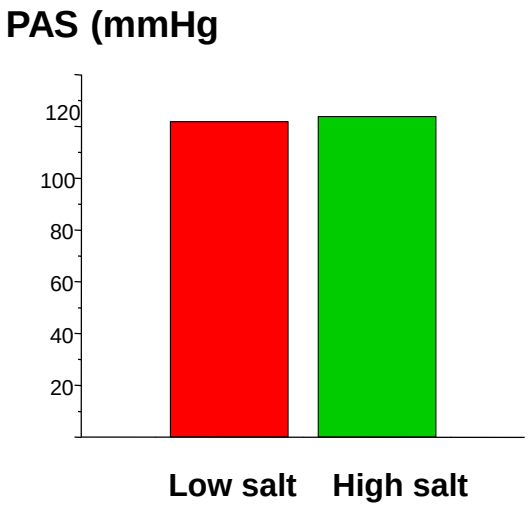
# Physiological role of sodium chloride

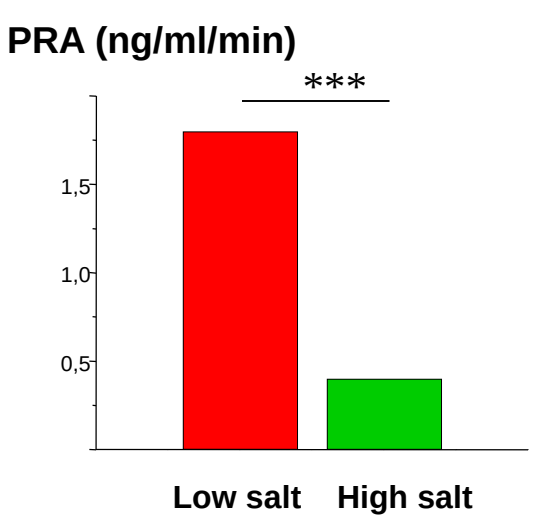
- 1. Maintenance of membrane potential
- 2. Nutrient absorption and transport
- 3. Maintenance of blood volume and blood pressure (importance of Chloride ion)

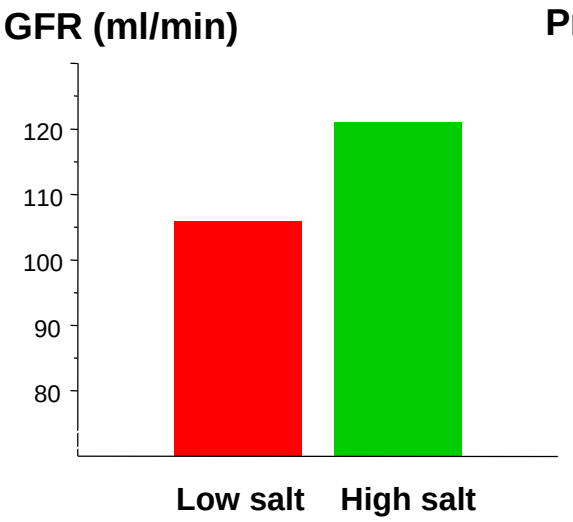


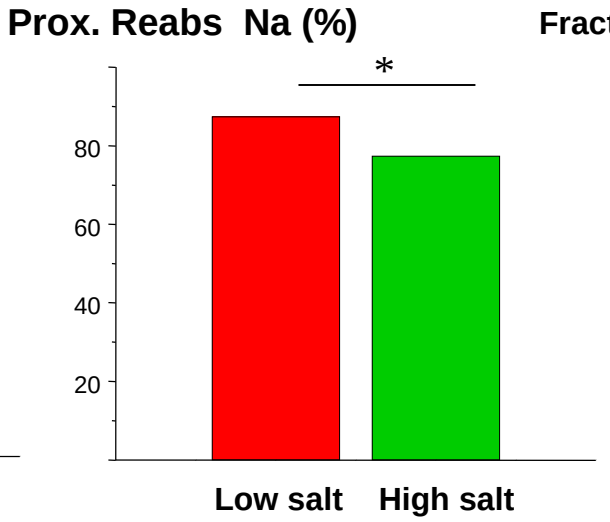
# Normal renal response to a change in sodium intake

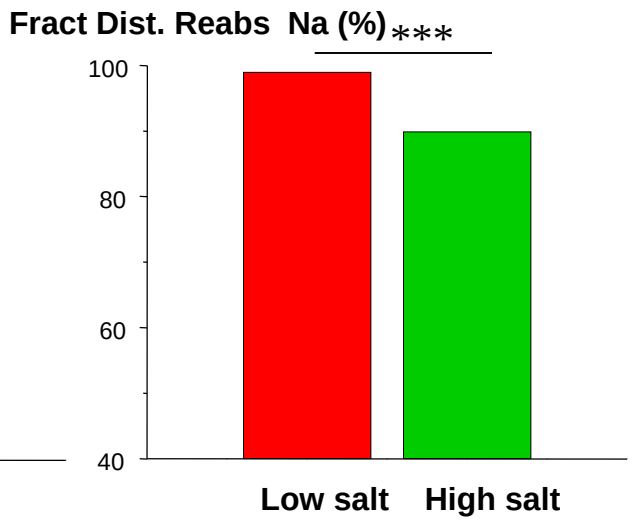


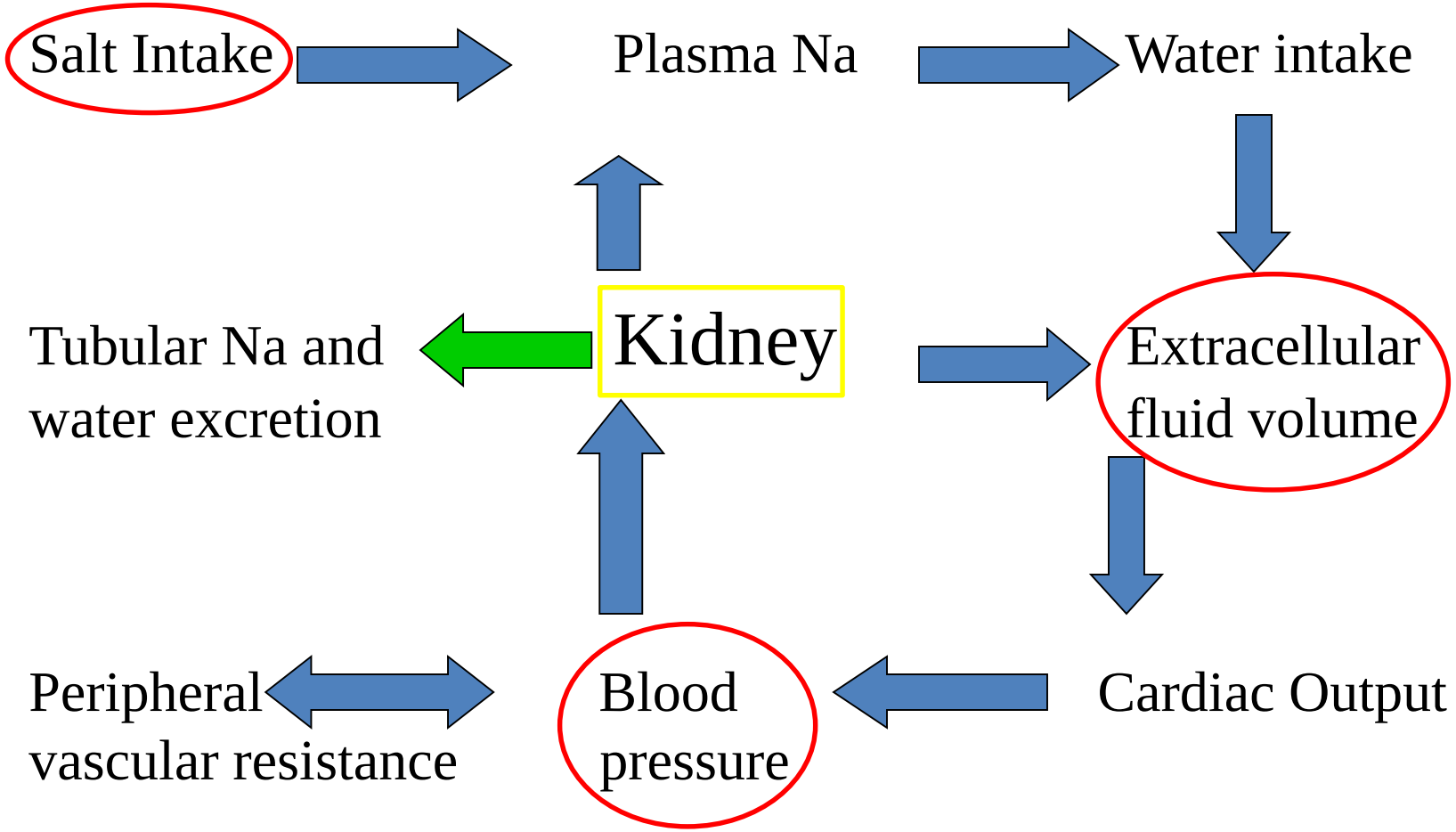




Burnier et al, J Hypertens 2000

# Role of the kidney in blood pressure control




Adapted from P. Menetton et al, Physiol Reviews, 2005

# Effets d’un excès alimentaire de sel

- Rôle sur la PA

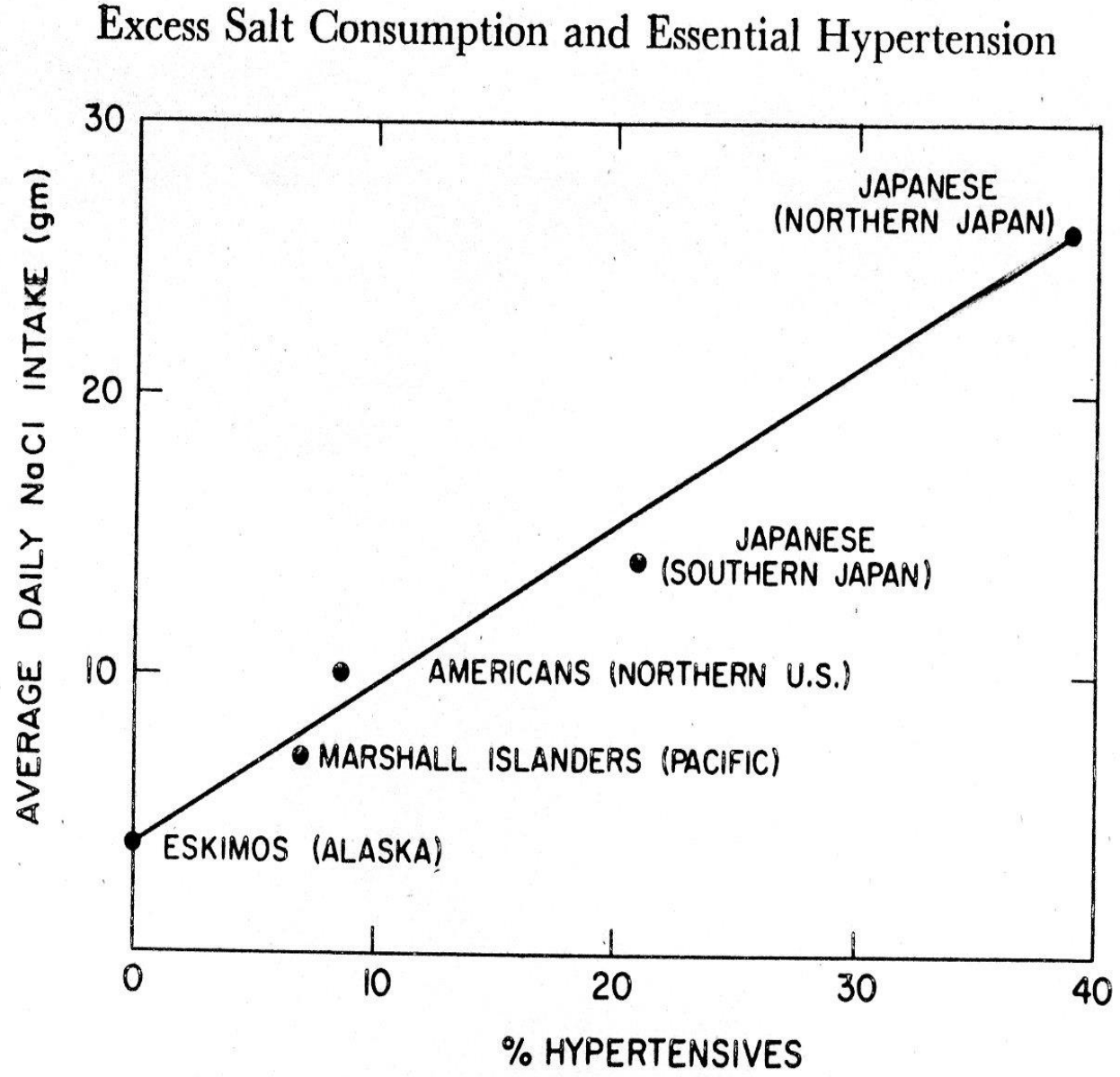
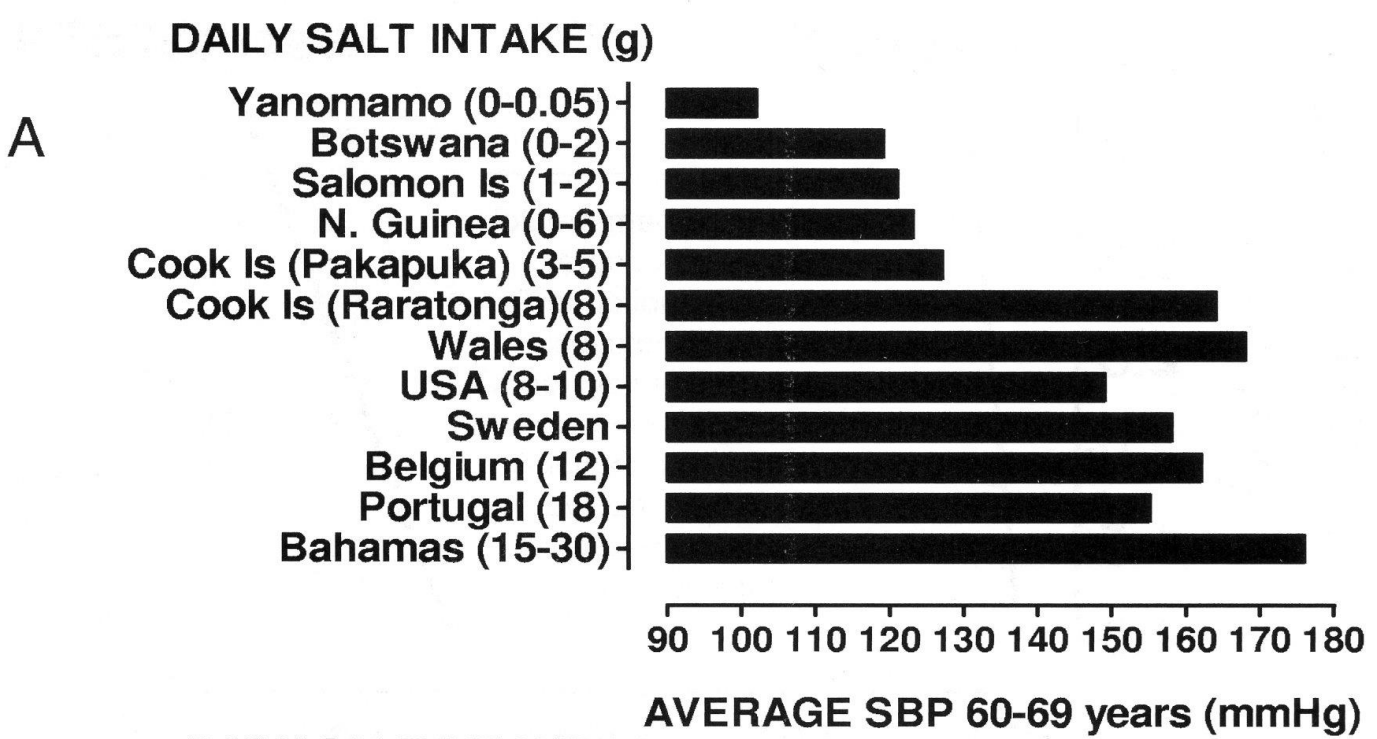



FIG. 1. Correlation of average daily salt (NaCl) intakes with prevalence of hypertension in different geographic areas and among different races. FROM: DAHL, L. K. In: Essential Hypertension. An International Symposium. Berlin, 1960. Springer-Verlag.



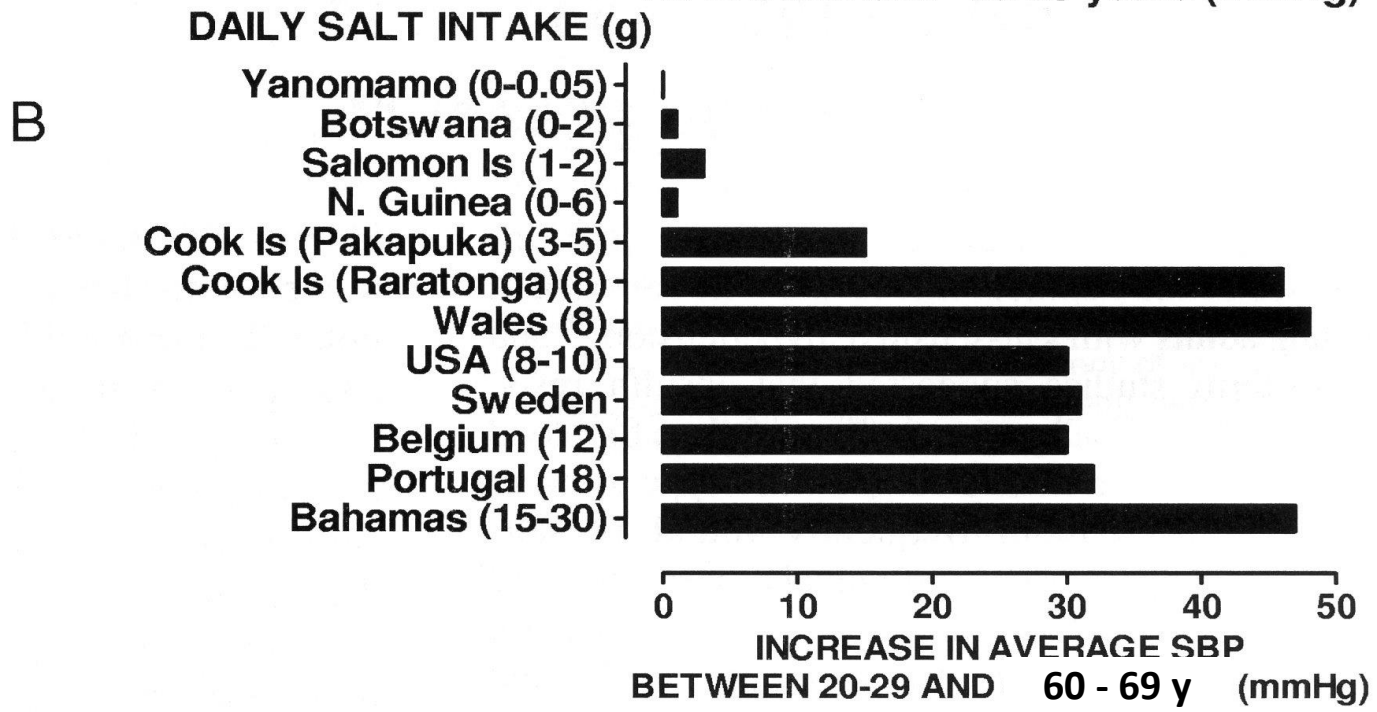
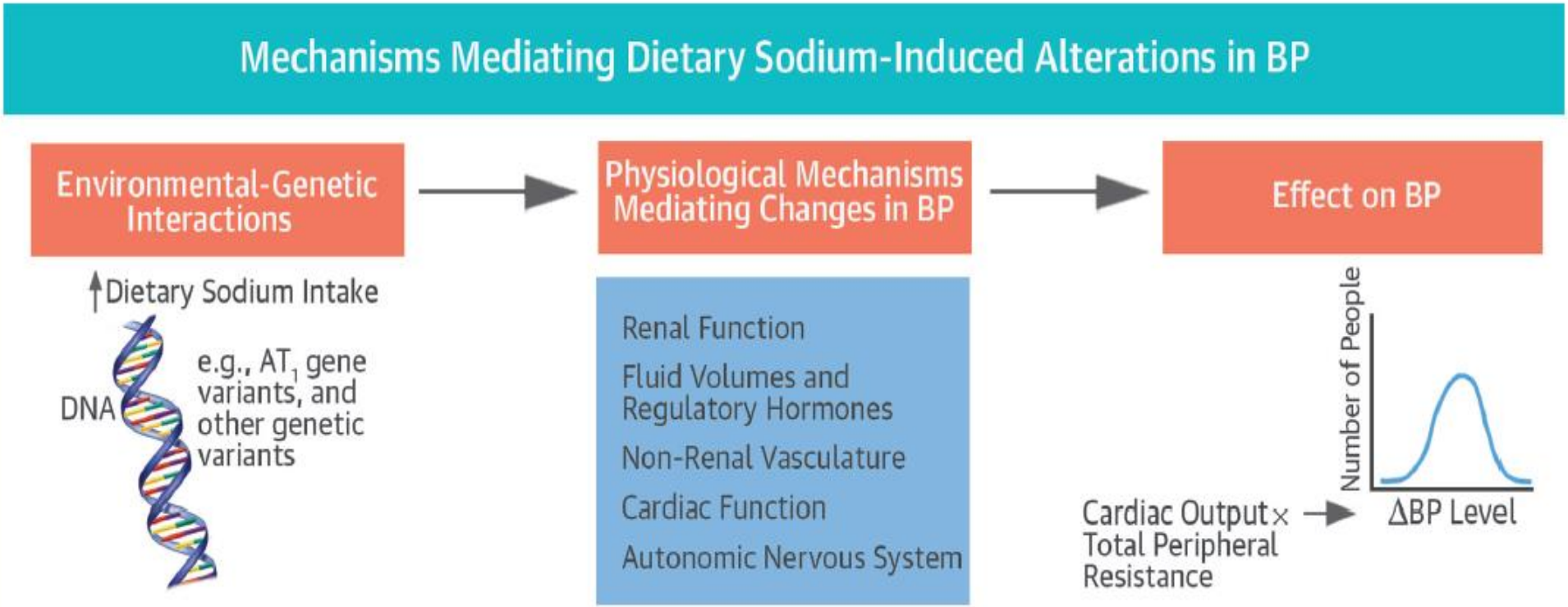




**Figure 2.** (A) Habitual daily salt intake and average systolic blood pressure (SBP) in selected populations 60 to 69 years old and (B) the difference in average SBPs at 20 to 29 years of age in the corresponding populations. More than 80% of hypertensive patients older than 60 years have salt sensitivity.[42] (Data adapted from Meneton et al,[11] who quoted Joosens JV: Dietary salt restriction: The case in favor. R Soc Med Ser 26:243-250, 1980.)

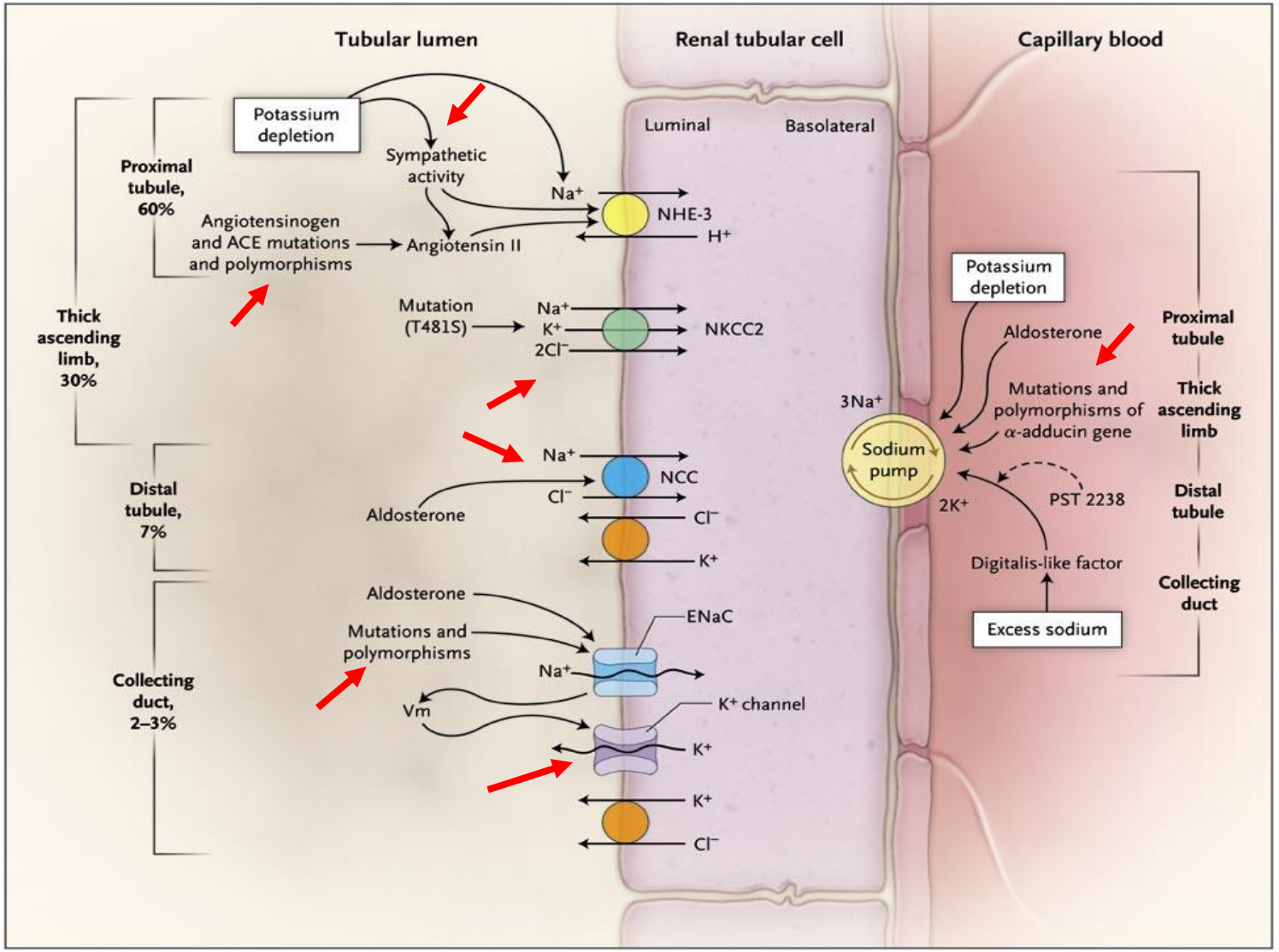
**CENTRAL ILLUSTRATION** Dietary Salt and Health




Farquhar, W.B. et al. J Am Coll Cardiol. 2015; 65(10):1042-50.

High dietary sodium can potentially exert its influence through various mechanisms to cause an increase in blood pressure (BP) through alterations in cardiac output and total peripheral resistance. The change (Δ) in BP varies considerably, even within a given population (as depicted in the distribution). $AT_1$ = angiotensin II receptor type 1.

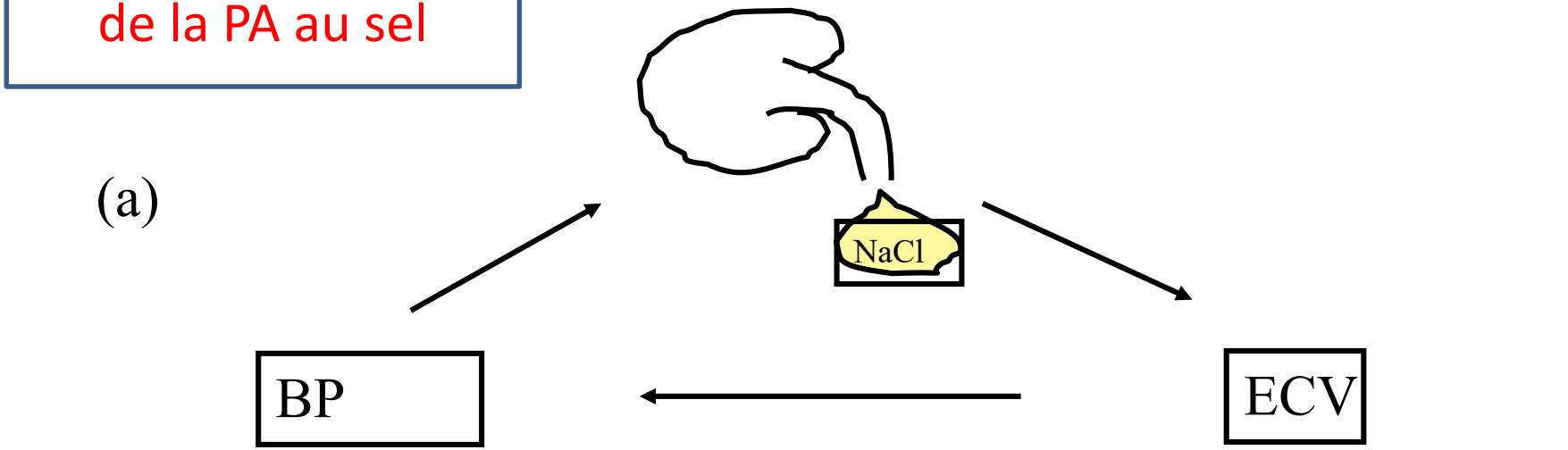
# Mechanisms Implicated in the Retention of Sodium and Loss of Potassium by the Kidneys in Primary Hypertension

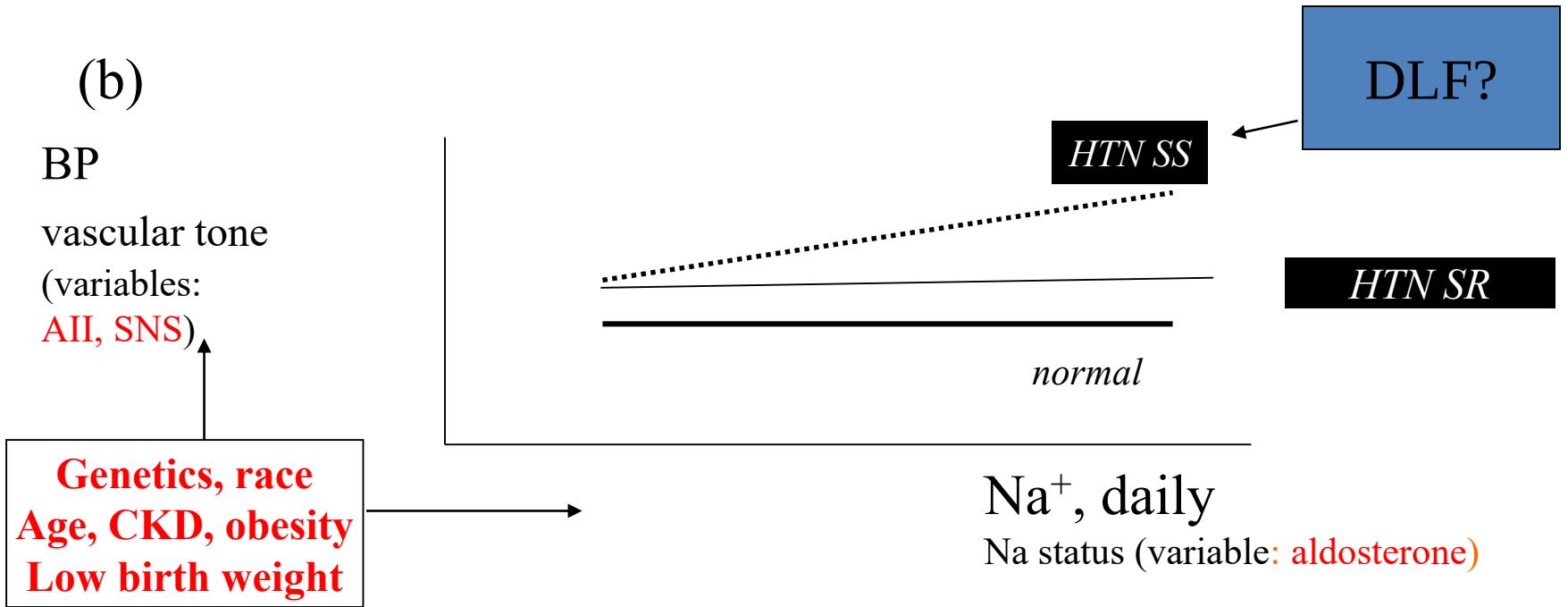



Adrogue H and Madias N. N Engl J Med 2007;356:1966-1978

# Notion de sensibilité de la PA au sel

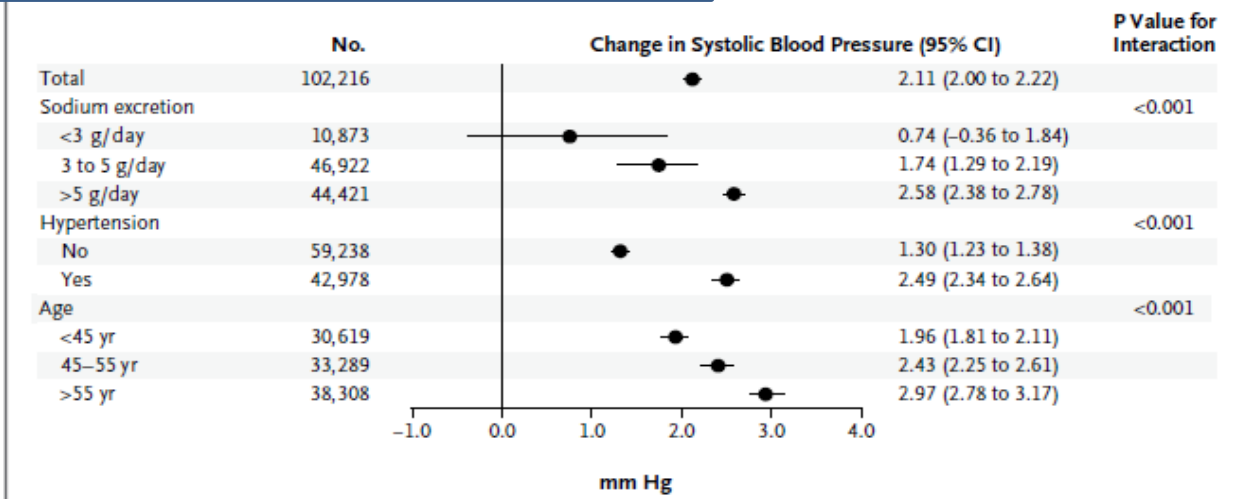
*figure 1*
*Krzesinski&Cohen*



# Association entre excrétion urinaire de sodium et PA

## 102000 adultes de 18 pays



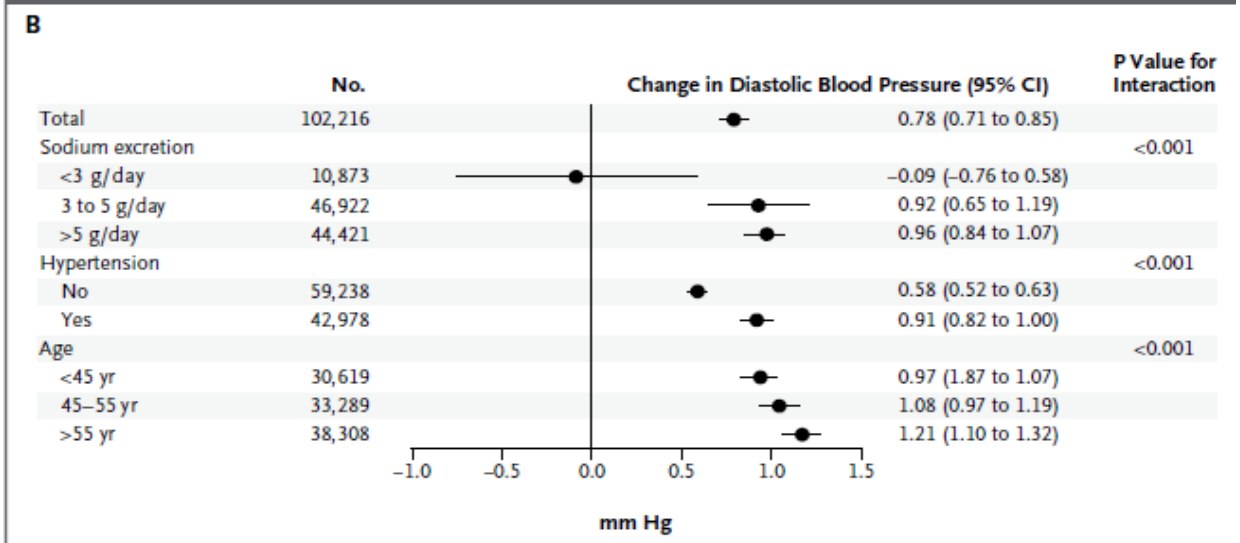



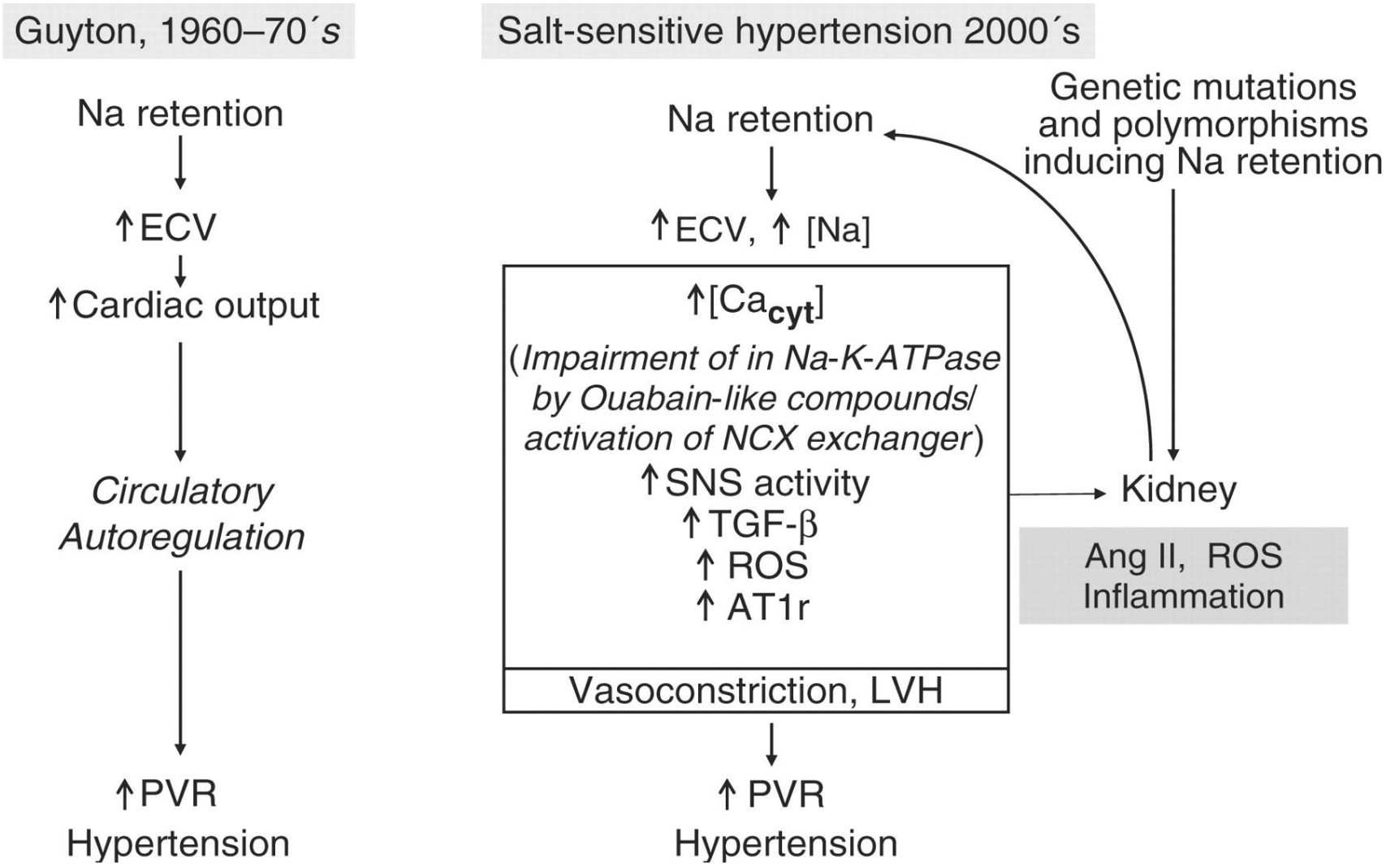

**Figure 3. Forest Plots of Changes in Systolic and Diastolic Blood Pressure for Every 1-g Increase in Sodium Excretion.**
Data are based on multivariable linear regression models with adjustment for covariates and regression dilution bias.

Prospective Urban Rural Epidemiology (PURE) study is provided in the Supplementary Appendix, available at NEJM.org.

N Engl J Med 2014;371:601-11.

Sensibilité au sel:
Age, Sévérité HTA

# Etiopathogenesis of salt-sensitive hypertension



# Disorders of Plasma Sodium — Causes, Consequences, and Correction

Richard H. Sterns, M.D.

N ENGL J MED 372;1 NEJM.ORG JANUARY 1, 2015

The NEW ENGLAND JOURNAL of MEDICINE

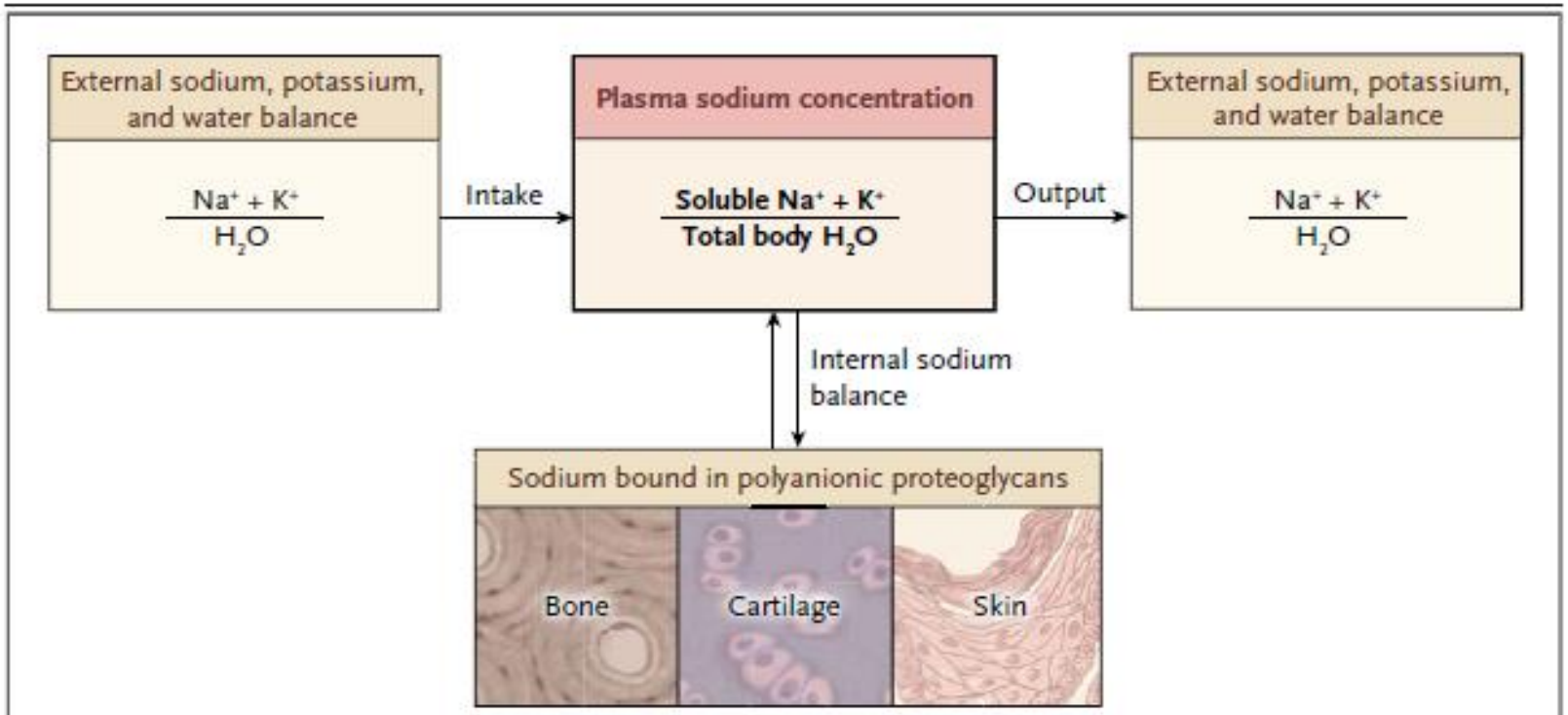
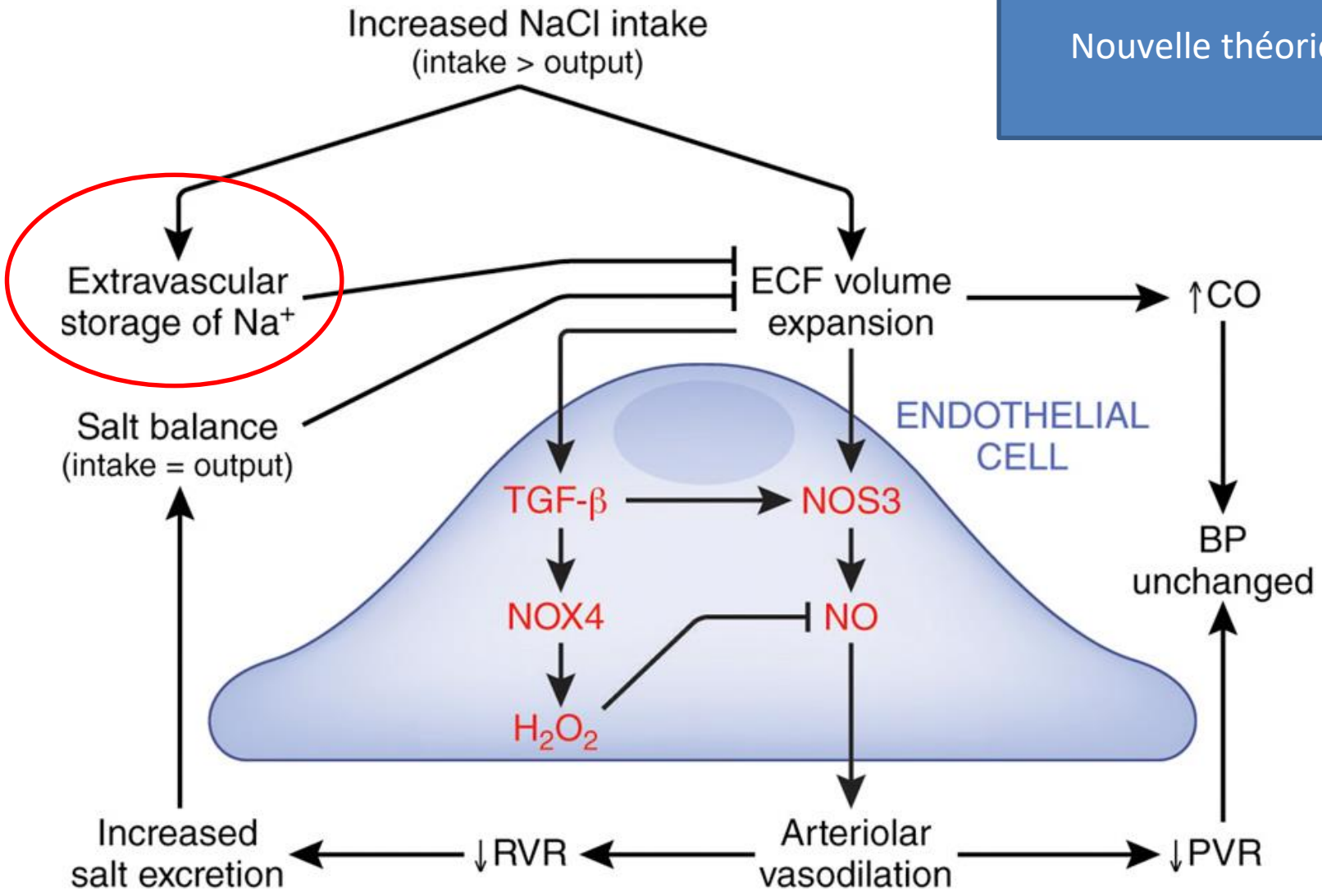



**Figure 1. Internal and External Solute and Water Balance and the Plasma Sodium Concentration.**

Nouvelle théorie



# Novel Paradigms of Salt and Hypertension

Wenguang Feng,* Louis J. Dell'Italia,*† and Paul W. Sanders*†‡

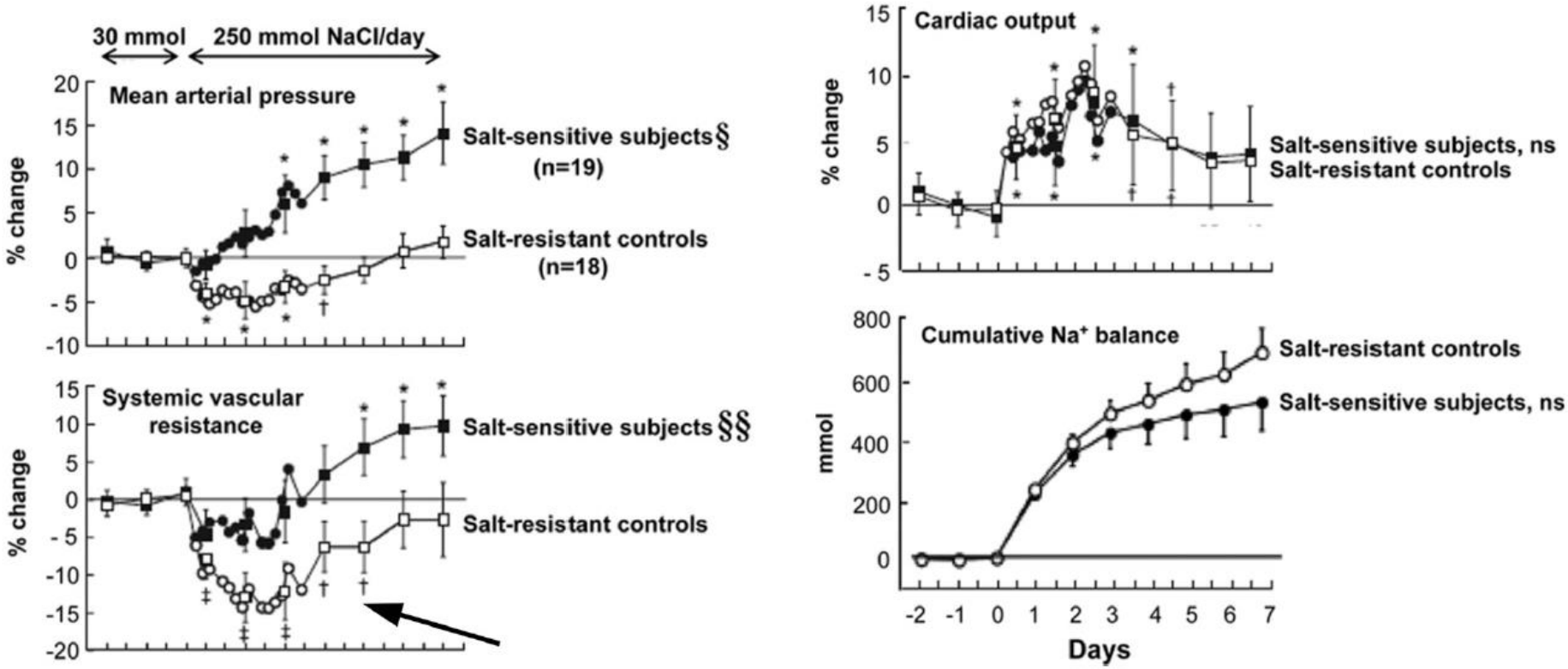



**Figure 3.** The hemodynamic effects of chronic high salt intake differed between SS and SR volunteers. Despite similar increases in CO (row 3) and cumulative sodium balance (row 4), SS but not SR patients manifested salt-induced increases in mean arterial pressure (row 1). The SR volunteers showed rapid reductions in calculated systemic vascular resistance (SVR; row 2), whereas SVR did not decline and actually increased over time in the SS patients. It is worth noting that SVR also increased with continued high salt ingestion in SR patients (arrow). *$P<0.01$; †$P<0.05$; §§$P<0.001$, compared with period of low salt intake. ns, not

*J Am Soc Nephrol* 28: 1362–1369, 2017.

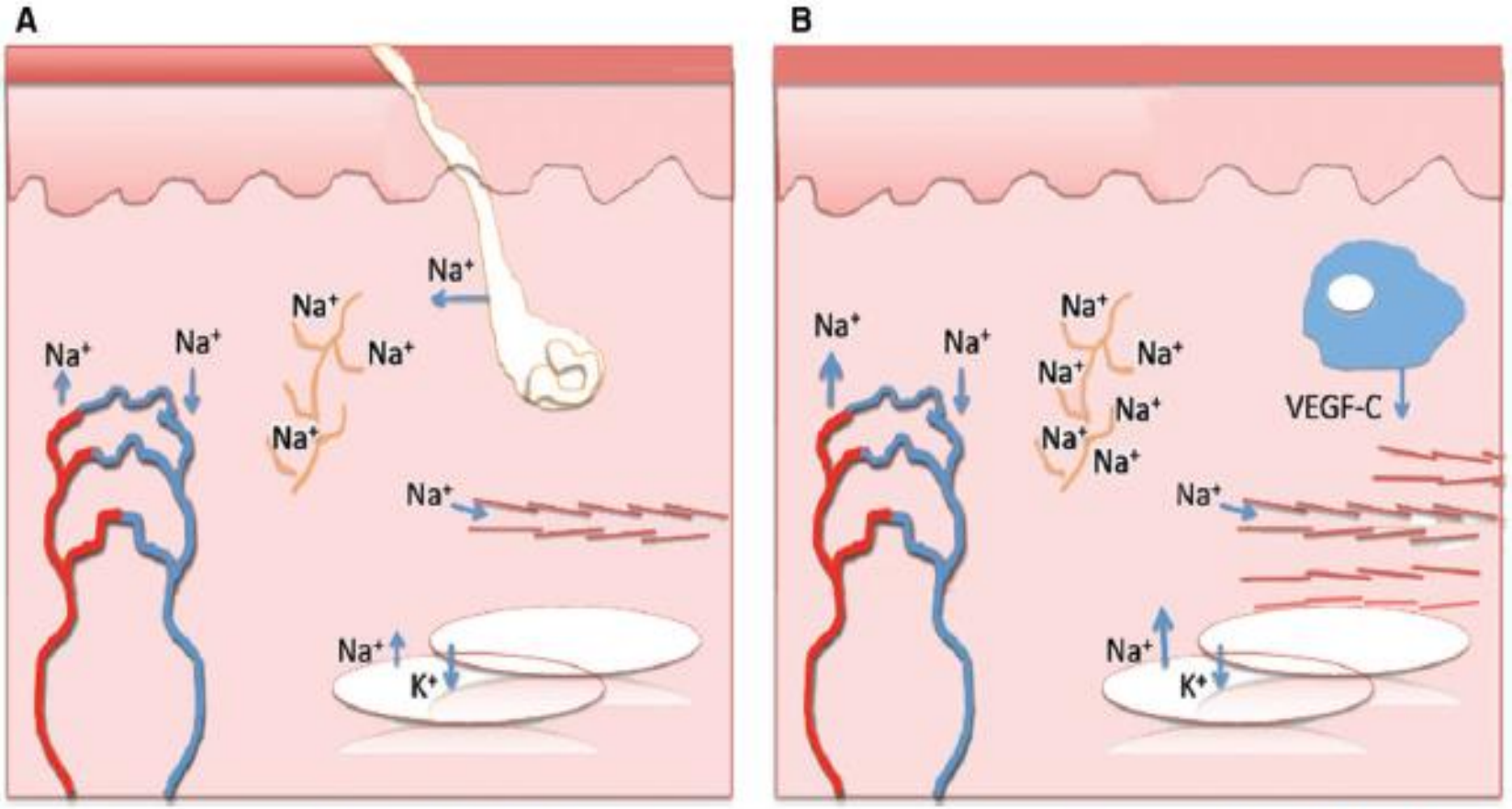



**Fig. 1.** Proposed new model of $Na^+$ balance in the subcutaneous compartment. (**A**) Normal physiology: $Na^+$ is filtrated into and reabsorbed from the interstitium at the level of the capillaries through the classical Starling equilibrium. In addition, $Na^+$ accumulates in the subcutaneous interstitium through reabsorption from sweat glands. Na/K-ATPase on the membrane of cells keeps $Na^+$ in the extracellular compartment. Polyanionic matrix molecules in the interstitium can bind $Na^+$ without commensurate water. A small part of $Na^+$ and interstitial fluid is transported back to the circulation through the lymphatic system. (**B**) Salt loading: $Na^+$ binding capacity of the matrix molecules is increased. In addition, $Na^+$ is less efficiently kept in the extracellular compartment through inhibition of Na/K-ATPase activity. However, when interstitial hypertonicity develops, despite these compensation mechanisms, influx of inflammatory cells can be observed that through an osmosensitive transcription factor release VEGF-C and induce lymphangiogenesis. The latter mechanism will increase $Na^+$ transport back into the circulation. 254 × 122 mm (300 × 300 DPI).

# Risque lié à un apport excessif en sel

- Rôle sur la PA via la volémie
- Rôle sur le système immunitaire et indirectement sur la PA

*Hypertension*. 2018;72:19-23.

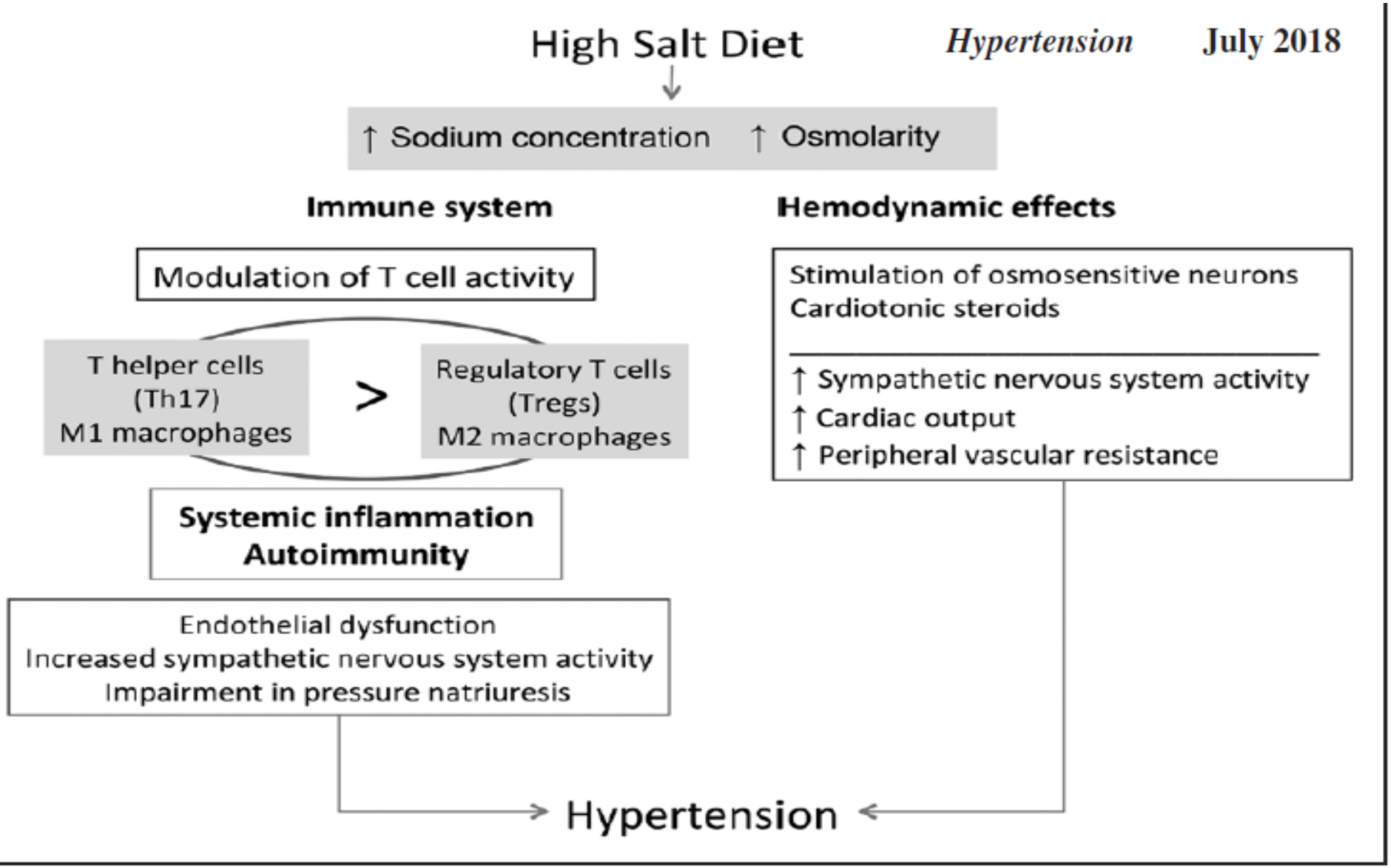
**Table. Impact of High-Salt Diet on Immune Cell Function**

| |
|---|
| Macrophages |
| Promotes macrophage infiltration in diverse tissues[17,25,26,48] |
| Promotes proinflammatory M1 macrophage activation[27,29] |
| Depresses anti inflammatory M2 macrophage activation[30] |
| T cells |
| Increased T-cell infiltration, proliferation, and activation[49] |
| Promotes Th17 activation |
| Boosts the development of IL-17-producing $CD4^+$ Th17 cells[18,19,24,39] |
| Promotes Th17 activation via p38 MAPK-, NFAT-, and SGK1-dependent signaling[18] |
| Negative impact on Tregs |
| Impairs the function and development of regulatory forkhead box $P3^+$ Tregs[24,38] |
| Induces SGK1-signal transduction and promotes interferon release from Tregs which abrogates their suppressive effects[19] |
| Effects on other leukocytes |
| Splenic B cells[32] |
| Neutrophils[33] |
| Basophils[34] |
| Effects on dendritic cells |
| Increased sodium enters the dendritic cells via specific channels, and increased NADPH oxidase activity produces superoxide with subsequent formation of immunogenic isolevuglandin, promoting an autoimmune-like state leading to renal and vascular dysfunction and hypertension.[42] |

# Salt Intake and Immunity

Baris Afsar, Masanari Kuwabara, Alberto Ortiz, Aslihan Yerlikaya, Dimitrie Siriopol, Adrian Covic, Bernardo Rodriguez-Iturbe, Richard J. Johnson, Mehmet Kanbay

*Hypertension* July 2018



*Annu Rev Physiol.* 2018 February 10; 80: 283–307. doi:10.1146/annurev-physiol-021317-121134.

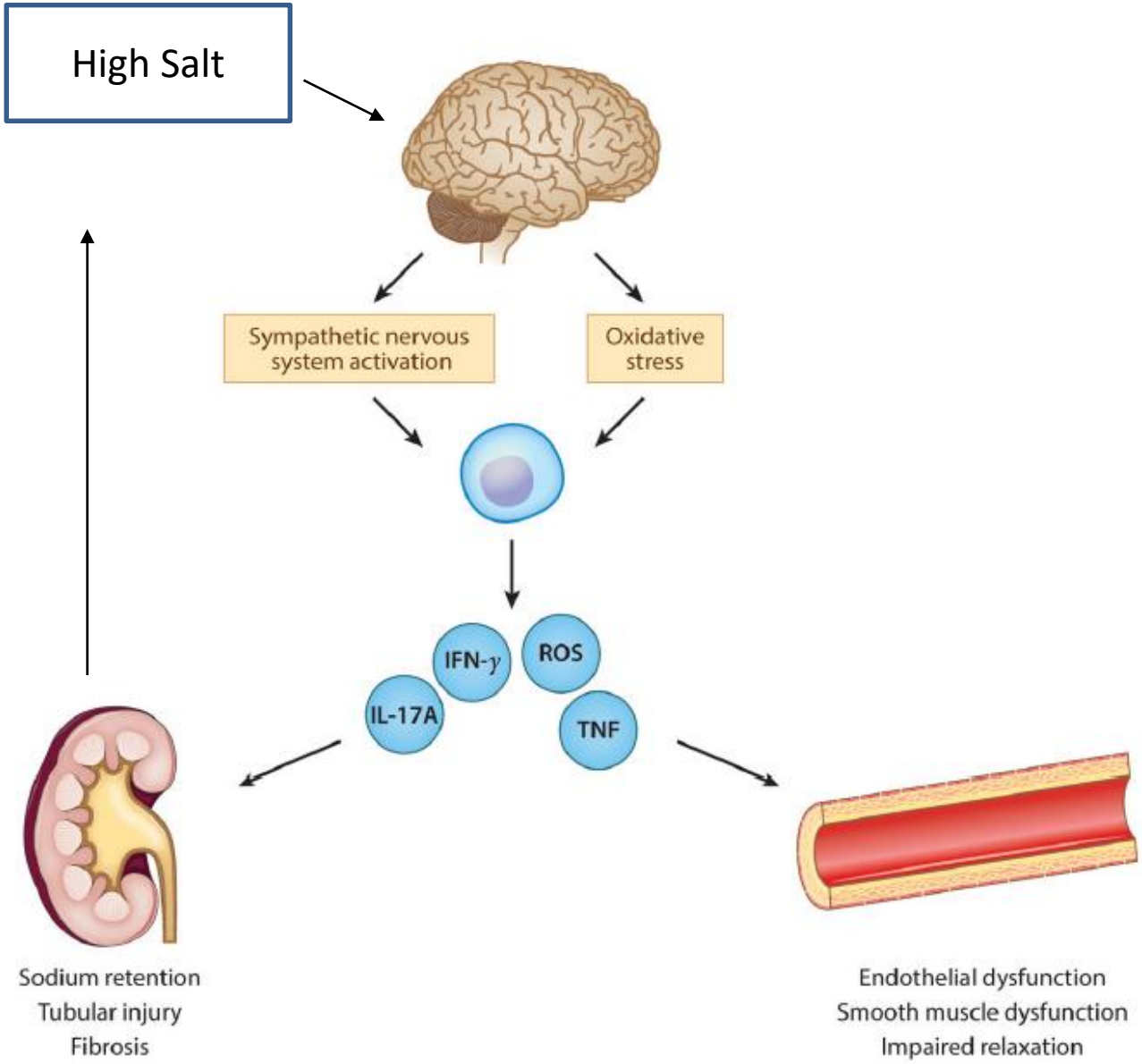



**Figure 3.**

Proposed roles of T lymphocytes in hypertension and salt sensitivity. Sympathetic nervous

## Salt, Hypertension, and Immunity

A. Justin Rucker[1,2], Nathan P. Rudemiller[1,2], and Steven D. Crowley[1,2]

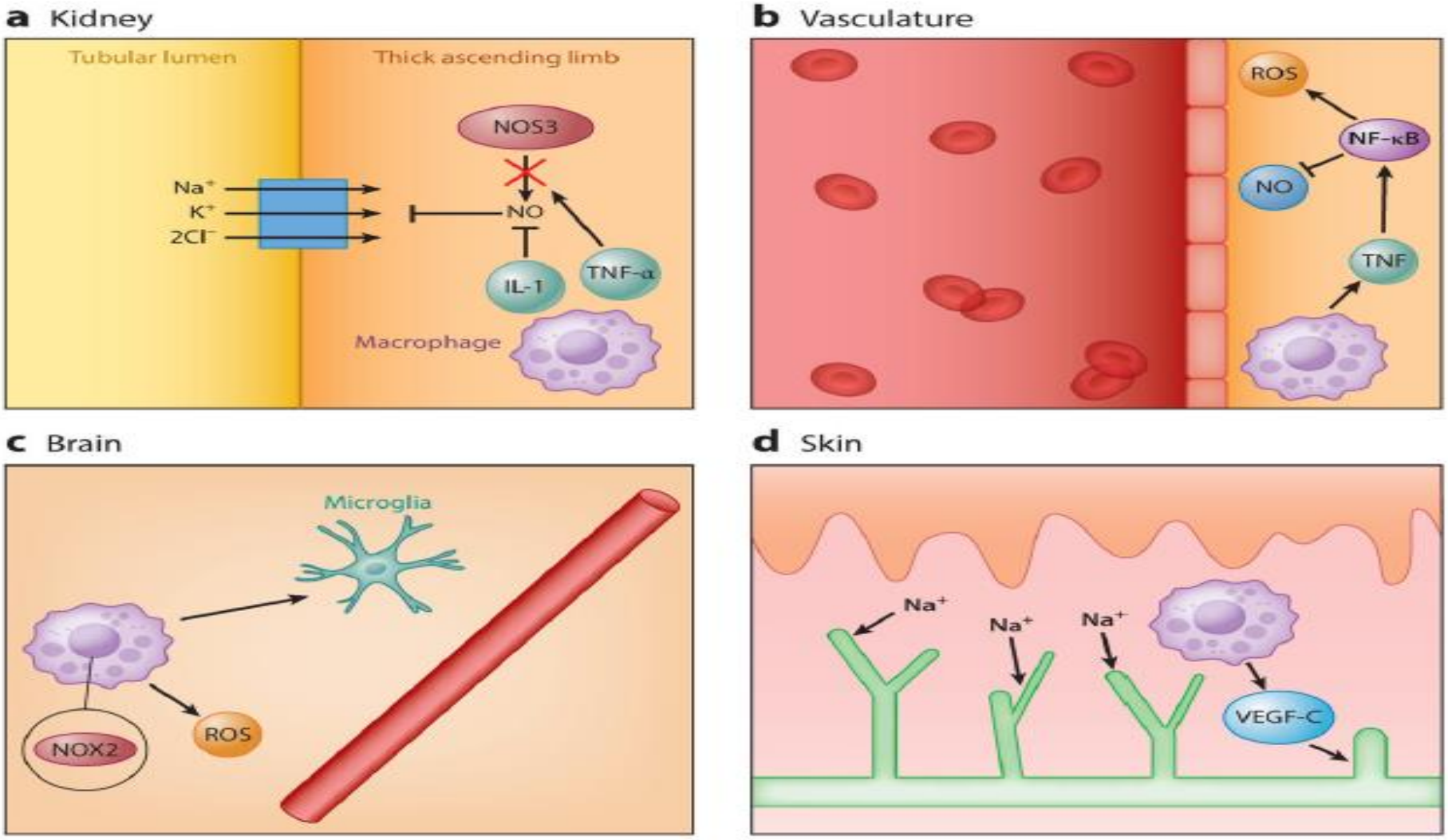
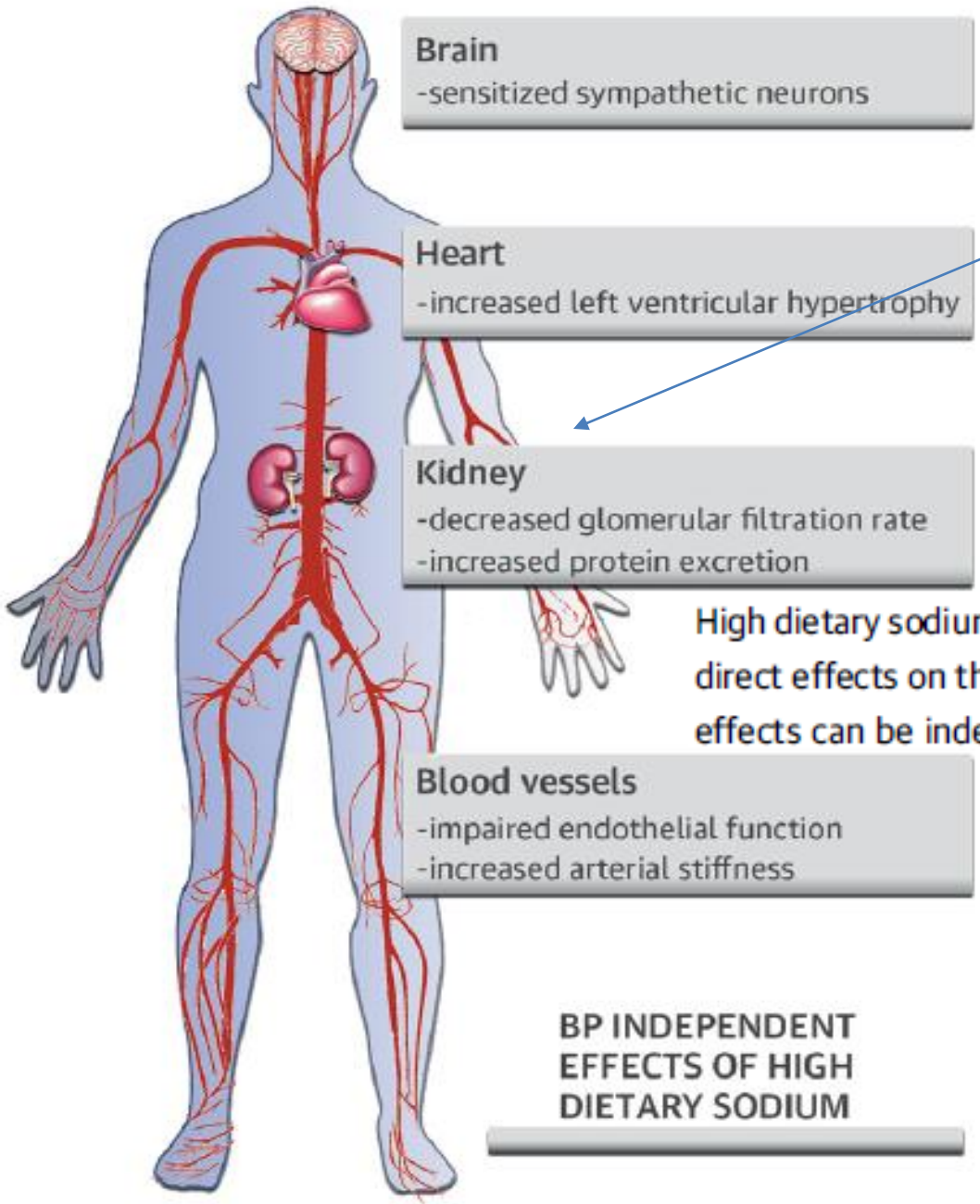



Illustration of the diverse roles for macrophages in salt-sensitive hypertension. Through generation of inflammatory cytokines and ROS, macrophages act in cardiovascular control centers to induce hypertension. (*a*) In the kidney, proinflammatory macrophage canonical

*Annu Rev Physiol.* 2018 February 10; 80: 283–307. doi:10.1146/annurev-physiol-021317-121134.

**FIGURE 1** BP-Independent Effects of High Dietary Sodium




Lithiase calcique

High dietary sodium can cause target organ damage and may have direct effects on the brain, heart, kidneys, and vasculature. These effects can be independent of changes in blood pressure (BP).

# Rôle délétère joué par le sel

- Rôle sur la PA
- Rôle via le système immunitaire
- Rôle via le microbiote intestinal

# A High Salt Diet Modulates the Gut Microbiota and Short Chain Fatty Acids Production in a Salt-Sensitive Hypertension Rat Model

*Nutrients* 2018, *10*, 1154; doi:10.3390/nu10091154

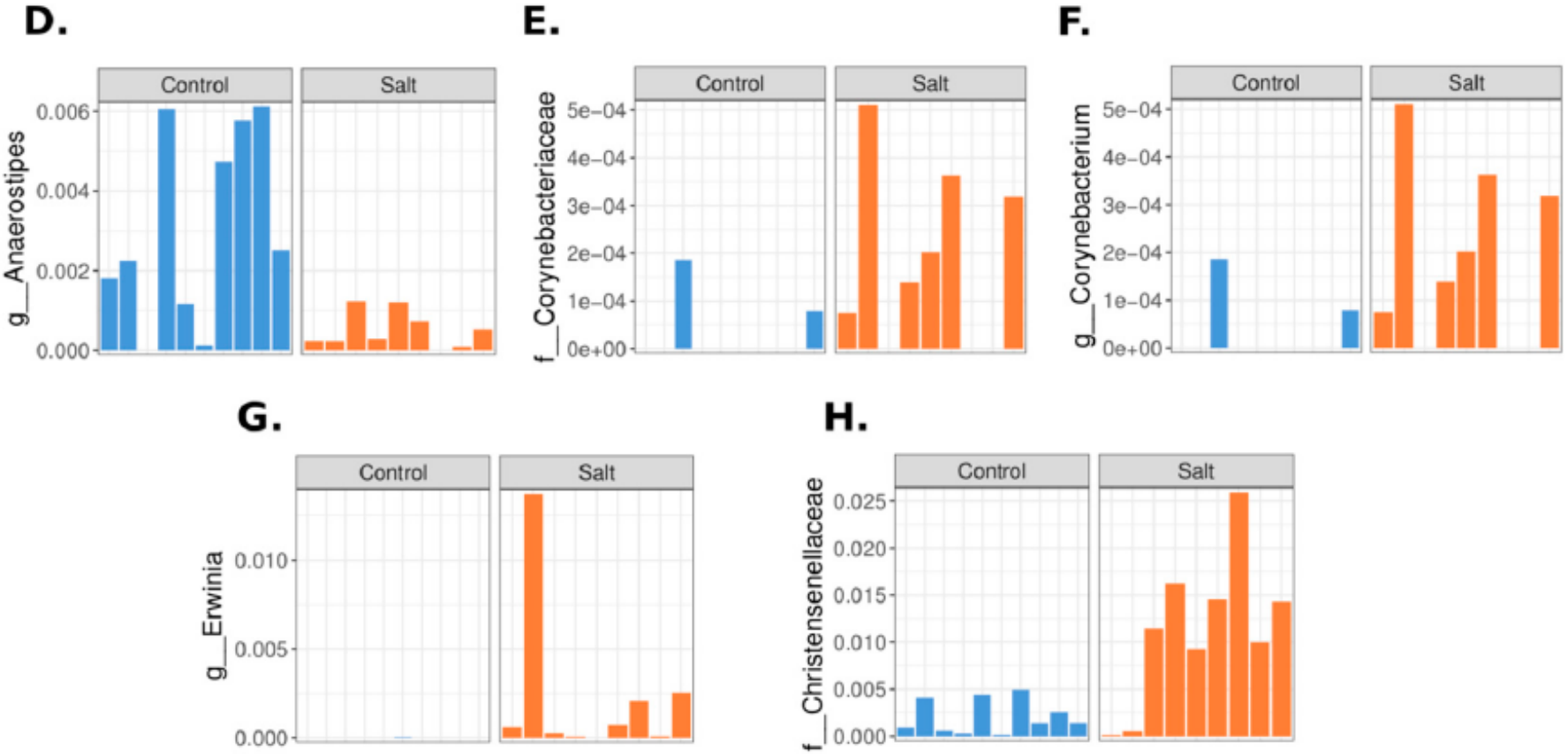



**Figure 2.** Microbial composition in high salt diet (HSD) differs from the control. Fecal pellets from HSD and control rats were analyzed using 16S rRNA-Amplicon Sequencing. Unweighted (**A**) and weighted

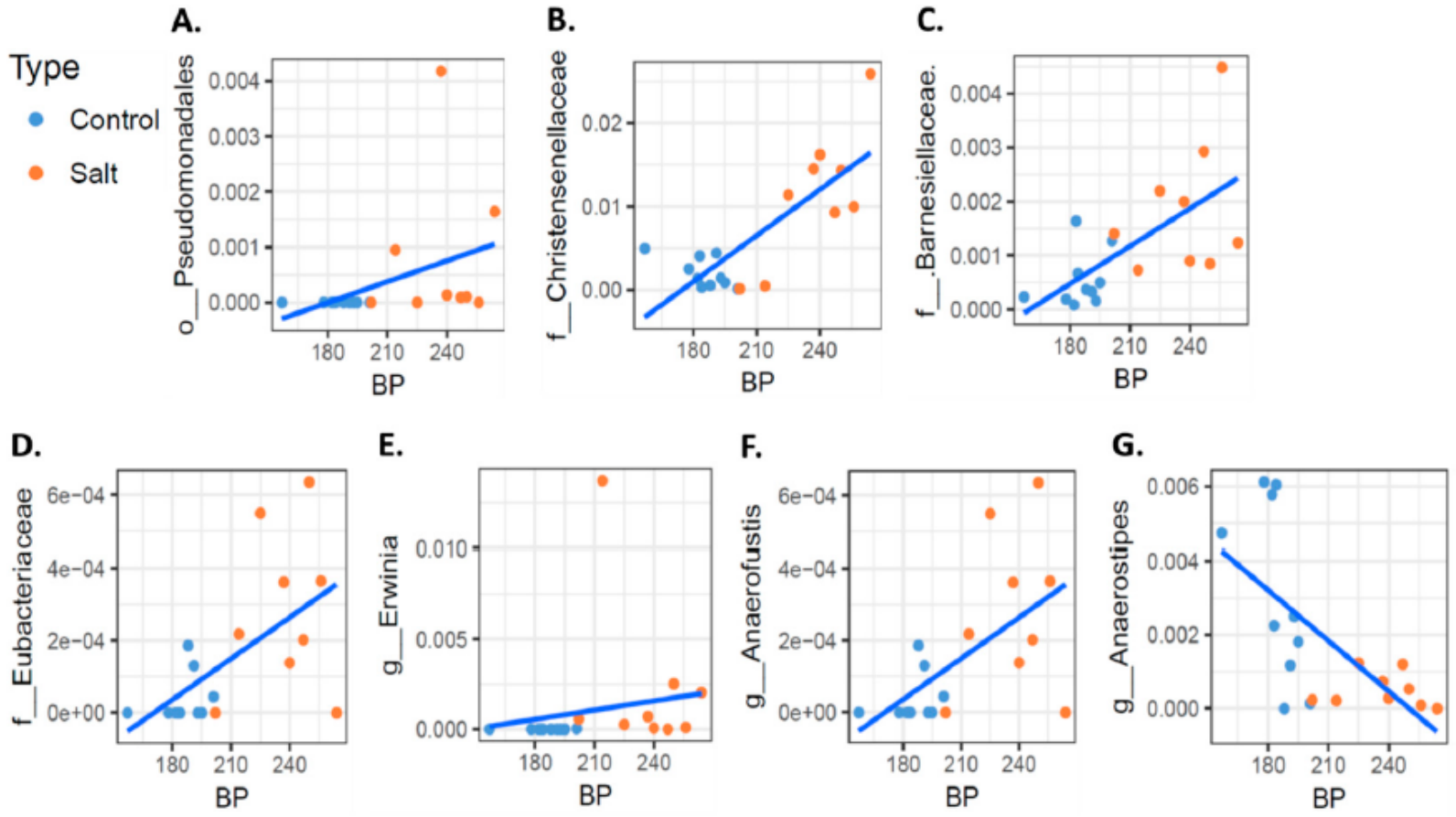



**Figure 3.** Correlation between blood pressure (BP) and bacterial taxa. Rat's BP values after 30 days were analyzed for their correlation with specific bacterial taxa; 7 microbial taxa displayed a significant correlation ($q$ value $\leq 0.1$) with BP (**A**–**G**) using the Multivariate Association with Linear Models (Maaslin) package Blue dots and red dots depict fecal samples from the high salt diet and controls, respectively.

# A High Salt Diet Modulates the Gut Microbiota and Short Chain Fatty Acids Production in a Salt-Sensitive Hypertension Rat Model

*Nutrients* 2018, *10*, 1154; doi:10.3390/nu10091154

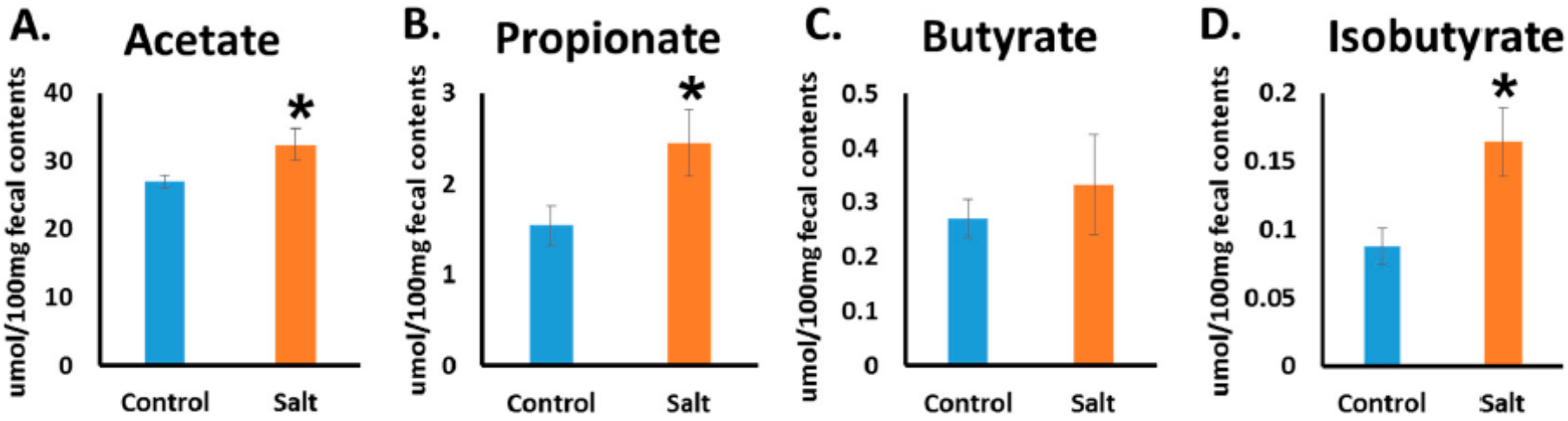



**Figure 4.** High salt diet elevated the SCFA level. The level of acetate (**A**); propionate (**B**); butyrate (**C**), and isobutyrate (**D**) were measured by GC-MS from fecal pellets at the end of the experiment. $n$ = 8–10, * $p \leq 0.05$.

# Risque lié au sel

- Rôle sur la PA par la volémie
- Rôle via le système immunitaire
- Rôle via le microbiote intestinal
- Rôle via la promotion de l’insulino-résistance

Nephrol Dial Transplant (2007) 22: 3102–3107
doi:10.1093/ndt/gfm409
Advance Access publication 30 June 2007

# Insulin resistance and salt-sensitive hypertension in metabolic syndrome

Toshiro Fujita

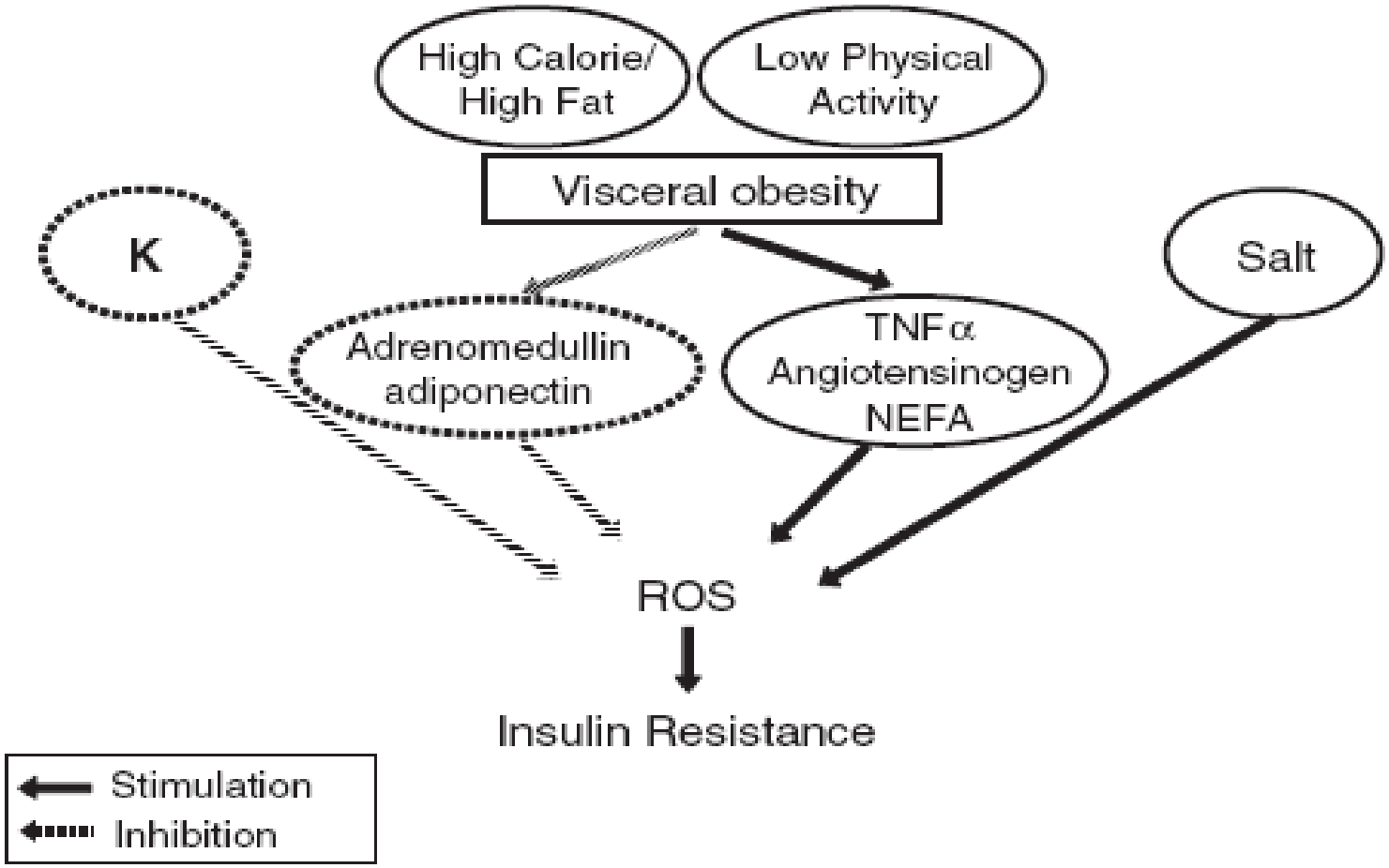



**Fig. 1.** Mechanism for insulin resistance in metabolic syndrome.

# High Salt Intake
## Independent Risk Factor for Obesity?

(*Hypertension*. 2015;66:843-849.

Yuan Ma, Feng J. He, Graham A. MacGregor

a direct association between salt intake and obesity independent of energy intake. We analyzed the data from the rolling cross-sectional study–the UK National Diet and Nutrition Survey 2008/2009 to 2011/2012. We included 458 children (52% boys; age, 10±4 years) and 785 adults (47% men; age, 49±17 years) who had complete 24-hour urine collections.

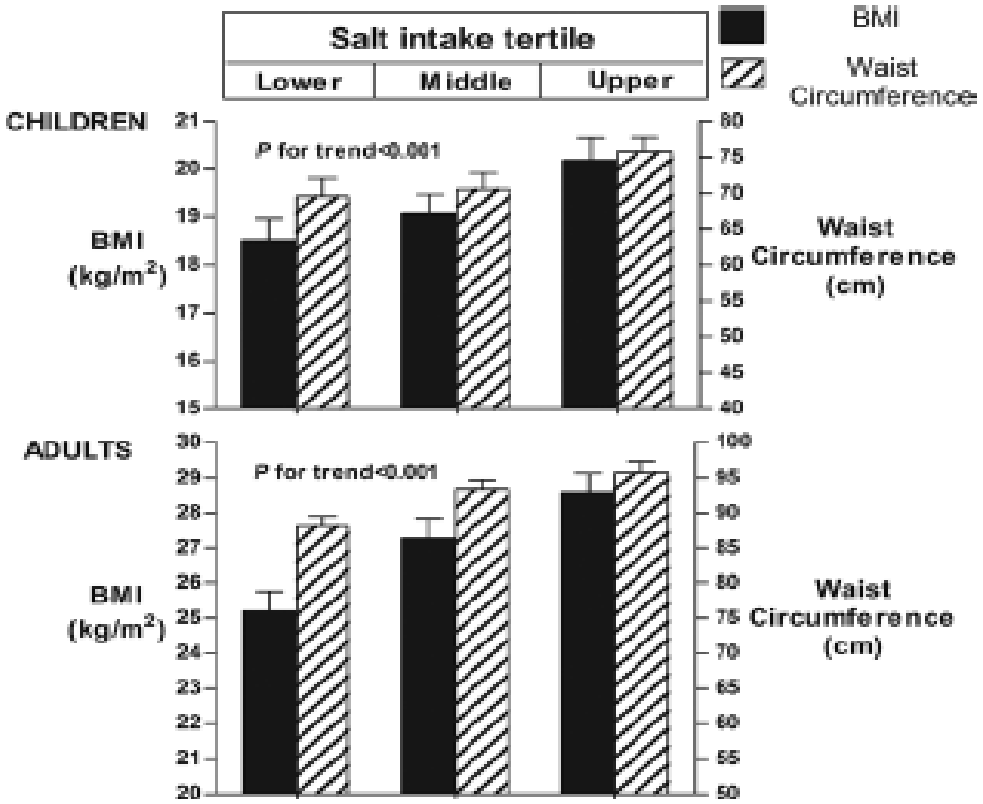



**Figure.** Adjusted mean body mass index (BMI) and waist circumference according to the tertiles of salt intakes measured by 24-hour urinary sodium excretion.

# Le sodium est-il seulement le seul acteur alimentaire dans le contrôle de la PA et du risque CV?

# Rôles joués par le sel

- Rôle sur la PA
- Rôle sur le système immunitaire
- Rôle sur le microbiote intestinal
- Rôle sur l'insulino-résistance et l'obésité
- Rôle atténué si alimentation riche en potassium

# Daily potassium intake and sodium-to-potassium ratio in the reduction of blood pressure: a meta-analysis of randomized controlled trials

Aristea Binia[a], Jonathan Jaeger[b], Youyou Hu[b], Anurag Singh[b], and Diane Zimmermann[c]

Paleolithic diet : K 150-290 mmol/d
Na 20-40 mmol/d

Modern diet : K 30-70 mmol/d
Na 80-250 mmol/d
So urinary Na/K around 3

Journal of Hypertension 2015, 33:1509–1520

# Association of Urinary Sodium and Potassium Excretion with Blood Pressure

102000 adultes de 18 pays

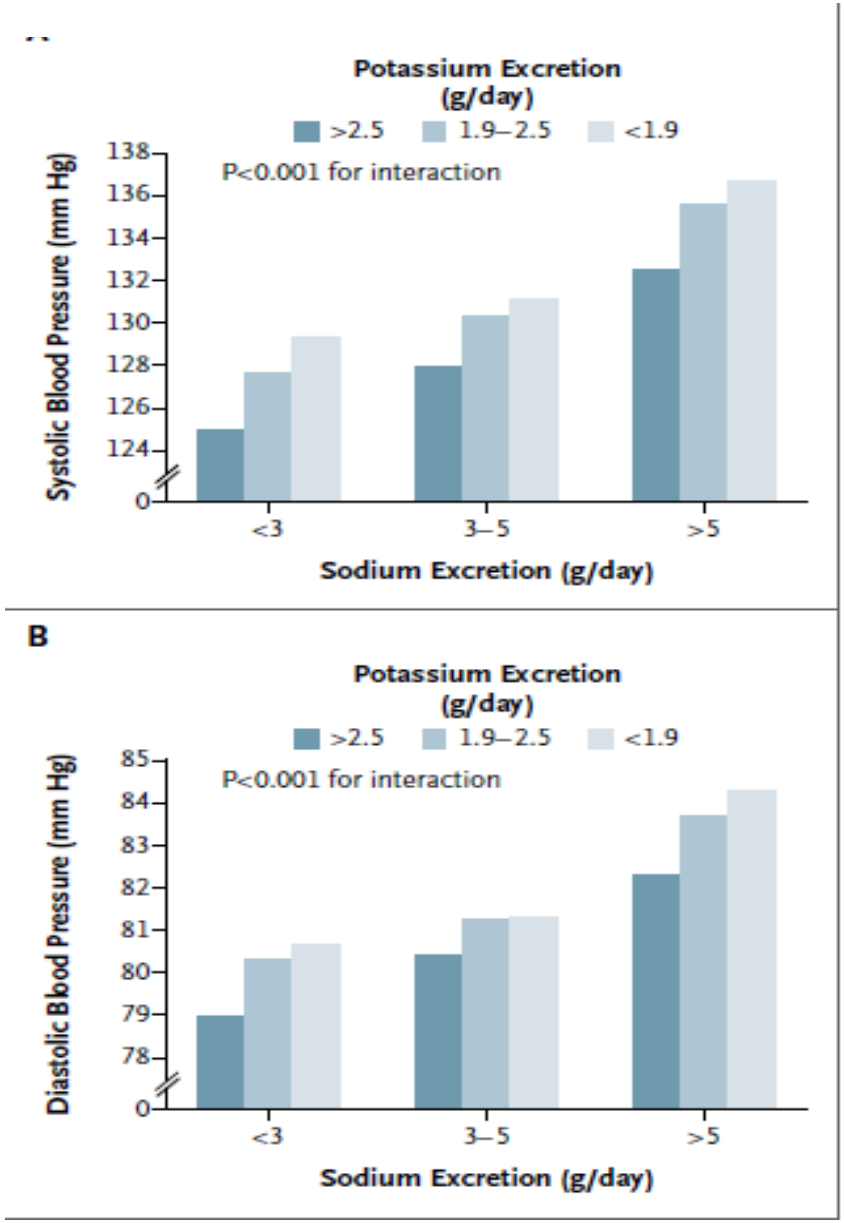



**Figure 4. Mean Systolic and Diastolic Blood Pressure According to Sodium and Potassium Excretion.**

Adjustment was made for age, sex, geographic region, body-mass index, educational level, and alcohol intake. The P value for interaction is for testing the joint effect of the two electrolytes on blood pressure.

Prospective Urban Rural Epidemiology (PURE) study is provided in the Supplementary Appendix, available at NEJM.org.

N Engl J Med 2014;371:601-11.

# Fruit and Vegetable Consumption and the Incidence of Hypertension in Three Prospective Cohort Studies

*Hypertension*. 2016;67:288-293.

**Table 2. Pooled Hazard Ratios (95% Confidence Intervals) of Incident Hypertension for Combined Total Fruits and Total Vegetables Consumption in Nurses' Health Study, Nurses' Health Study II ,and Health Professional Follow-up Study**

| | ≤1 per Day | 2–3 per Day | 4–5 per Day | ≥6 per Day | Linear *P* Trend |
|---|---|---|---|---|---|
| Total Fruits and Vegetables | | | | | |
| NHS* | 1052/31 868 | 11 318/339 541 | 13 914/396 152 | 9091/266 861 | |
| Adjusted hazard ratio† | 1.00 (reference) | 0.90 (0.84–0.95) | 0.88 (0.83–0.94) | 0.85 (0.80–0.91) | <0.001 |
| NHS II‡ | 1427/79 840 | 10 019/528 610 | 8785/462 410 | 5015/273 616 | |
| Adjusted hazard ratio† | 1.00 | 0.97 (0.92–1.03) | 0.95 (0.89–1.00) | 0.94 (0.88–0.99) | 0.02 |
| HPFS§ | 666/22 176 | 5711/190 017 | 6085/201 161 | 4290/146 874 | |
| Adjusted hazard ratio† | 1.00 | 0.93 (0.85–1.01) | 0.91 (0.83–0.98) | 0.89 (0.81–0.97) | 0.02 |
| Pooled results‖ | 1.00 | 0.94 (0.90–0.97) | 0.91 (0.88–0.95) | 0.89 (0.86–0.93) | <0.001 |

HPFS indicates Health Professionals Follow-up Study; and NHS, Nurses' Health Study.

*Follow-up in Nurses' Health Study was from 1984 to 2010 (cases/persons-years).

†Adjusted for age, race/ethnicity (white, African American, Asian, Hispanic, other), body mass index, current smoking status, physical activity, weight change per food frequency questionnaire cycle, menopausal status (NHS and NHS II), alcohol intake, current oral contraceptive use (NHS II), analgesic use (nonsteroidal antiinflammatory drugs, acetaminophen, aspirin), family history of hypertension, total energy intake, animal flesh intake (combination of processed and unprocessed red meat, poultry and seafood), whole grains, sugar-sweetened beverage intake, artificially sweetened diet beverage intake.

‡Follow-up in Nurses' Health Study II was from 1991 to 2011.

§Follow-up in Health Professionals Follow-up study was from 1986 to 2010.

‖Pooled hazard ratios of the 3 cohorts using a fixed effects model.

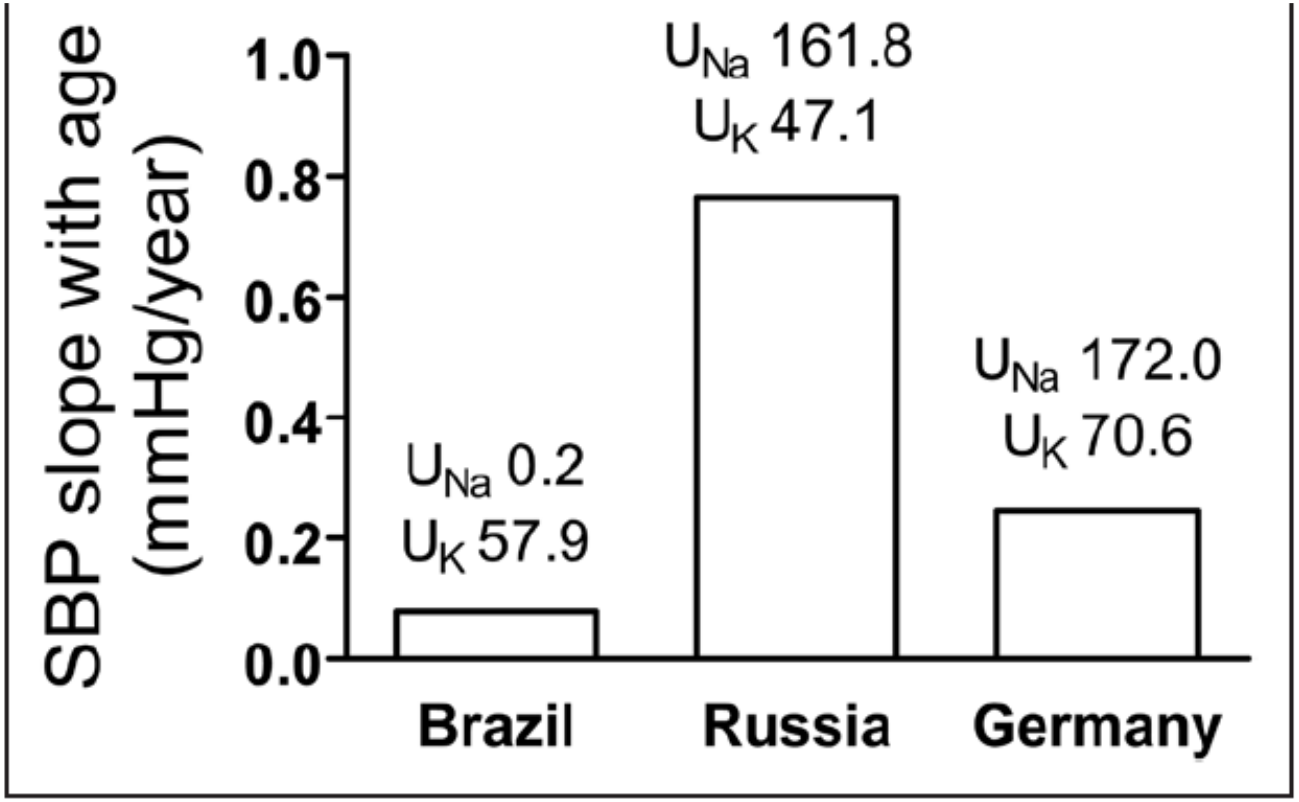



**Figure 1.** Comparison of blood pressure (BP) slopes (systolic BP [SBP] increase in mm Hg/y) and urinary $Na^+$ and $K^+$ excretion ($U_{Na}$, $U_K$) of 3 selected cohorts from the Intersalt study.[12] The Brazilian cohort consists of the Yanomamo Indians whose diet primarily consists of $K^+$ salts and who show almost no BP increase with aging. The Russian and German cohorts had similar $U_{Na}$, whereas $U_K$ was 1.5 fold higher in the German cohort. This may have contributed to the remarkable difference in SBP slope between the people in these 2 countries.

# Gritter et al K⁺ in BP Reduction and Cardiorenal Protection

HTA 2019

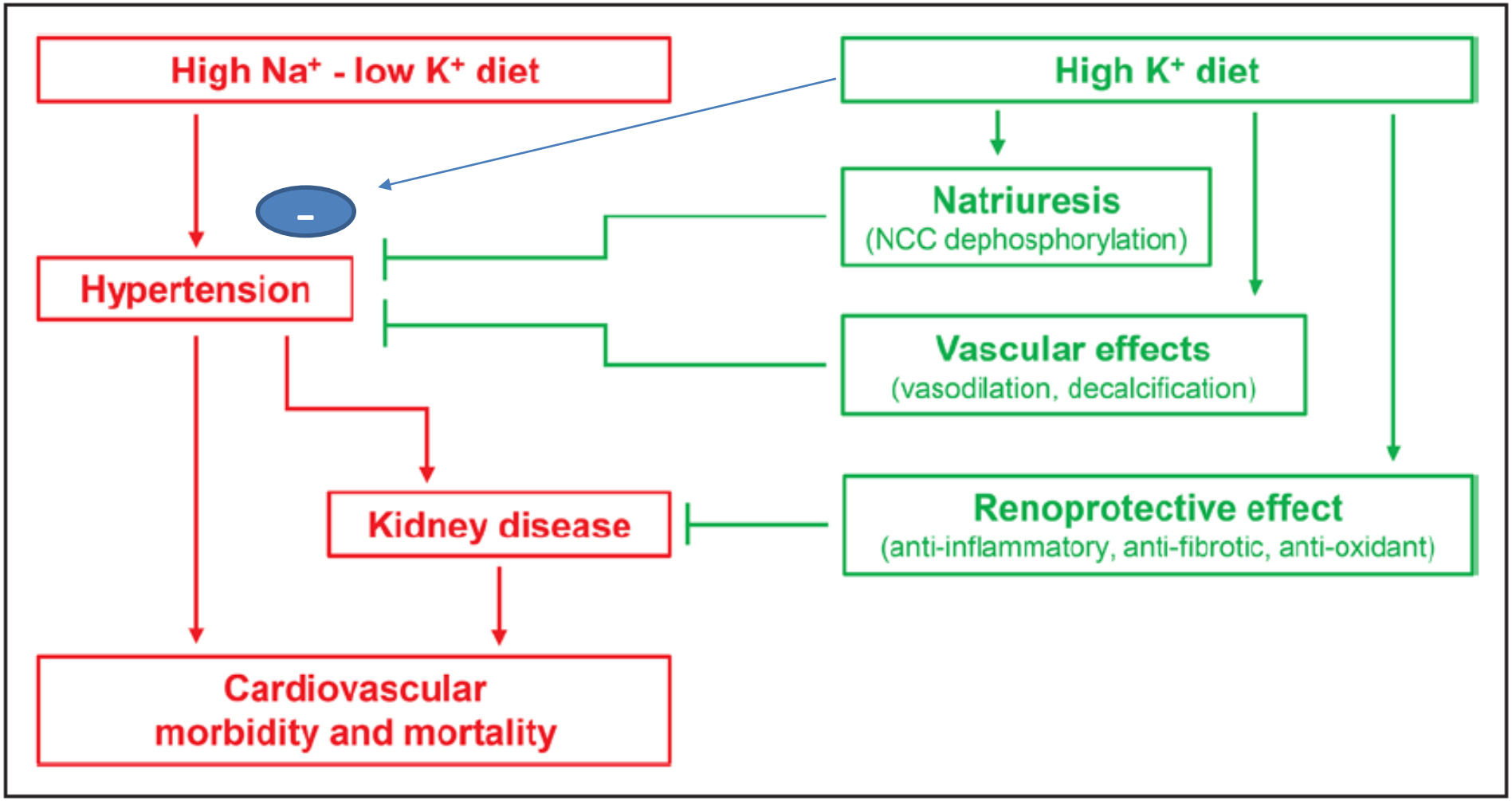



**Figure 2.** Proposed pathways through which high $K^+$ can reduce blood pressure and provide cardiovascular and renal protection. The left

# Dietary recommendations for Sodium and Potassium and BP

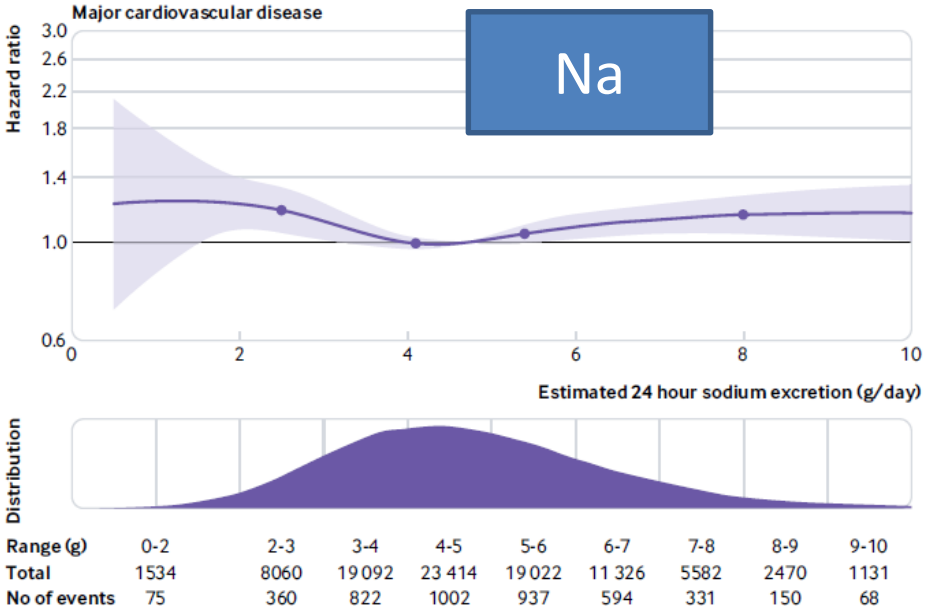
WHO recommendation (Weaver C Adv Nut 2013):
The ideal would be to lower sodium intake to < 100 mmol/d
and to increase potassium intake to > 90 mmol/d,
so the **urinary Na/K ratio should be near 1-1.5**

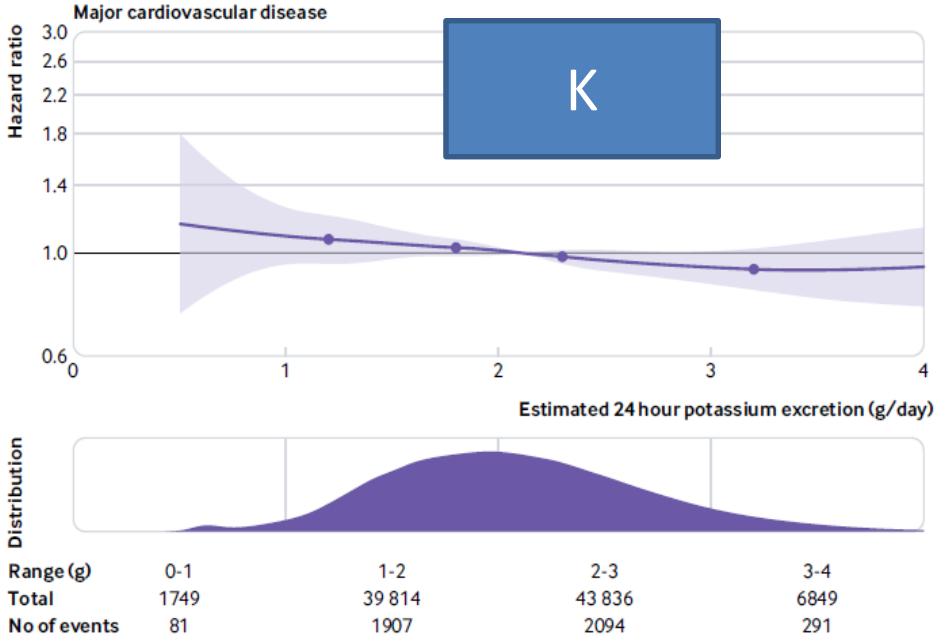
# Joint association of urinary sodium and potassium excretion with cardiovascular events and mortality: prospective cohort study

: *BMJ* 2019;364:l772

Dietary guidelines recommend sodium restriction but increased potassium intake (WHO recommends <2.0 g/day and >3.5 g/day, respectively)

Studies evaluation the association of sodium intake have reported inconsistent findings, but many report a J-shaped association, while those evaluating potassium intake generally report a linear reduction in mortality with increasing potassium intake




The combination of moderate sodium intake (3-5 g/day) with higher potassium intake was associated with the lowest risk of mortality and cardiovascular events

*Ageing Res Rev*. 2017 October ; 39: 106–119. doi:10.1016/j.arr.2016.09.002.

## Nutrition and other Lifestyle Influences on Arterial Aging

**Thomas J. LaRocca**, **Christopher R. Martens**, and **Douglas R. Seals**

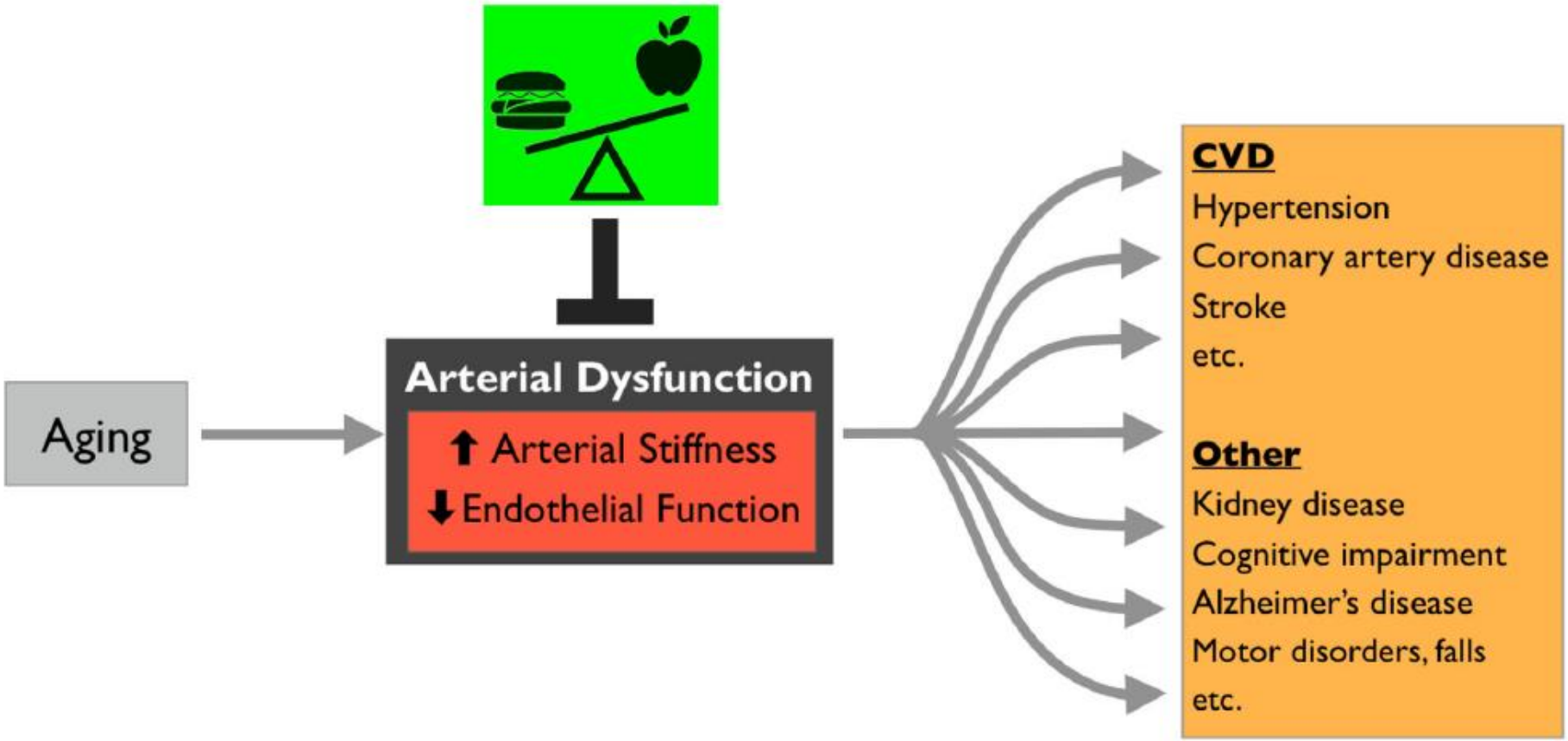
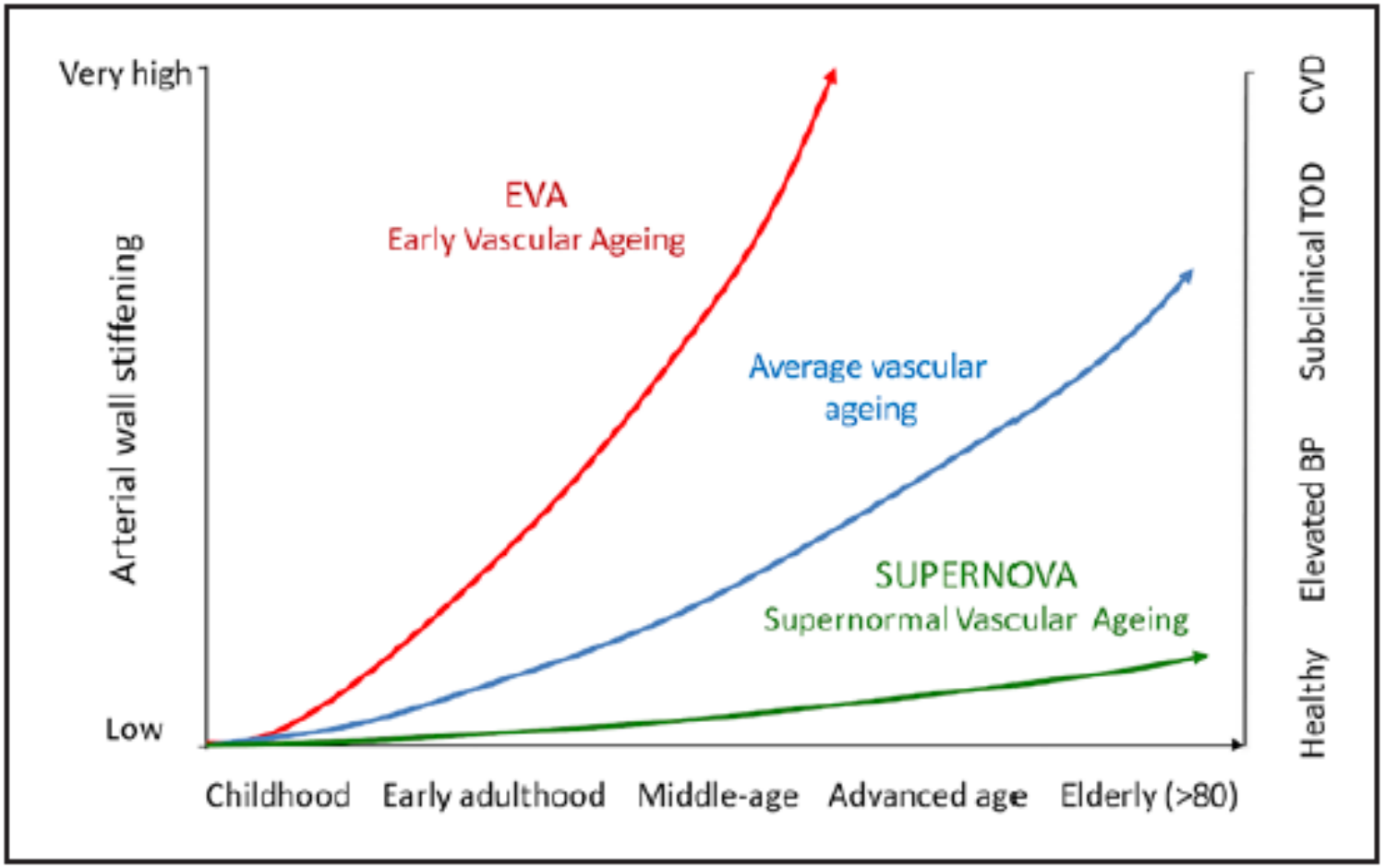



**Figure 1.**

Aging leads to arterial dysfunction (increased stiffness and reduced endothelial function) that predisposes us to cardiovascular diseases (CVD) and other chronic disorders. Diet/ nutrition has the potential to modulate/prevent arterial dysfunction with aging.

# Early, Normal, and Supernormal Vascular Aging




*Hypertension*. 2019;74:218-228.

# Place du sodium dans le processus de vieillissement vasculaire

**Table. Putative Determinants of EVA and SUPERNOVA**

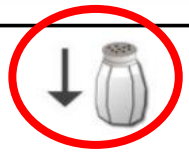
| Nonmodifiable Determinants | Determinants of EVA | Determinants of SUPERNOVA |
|---|---|---|
| Chronological age | | |
| Ethnicity | | |
| Sex | | |
| Family history | | |
| Prenatal fetal growth | | |
| Genetics | | |
| | Classical CV risk factors | |
| | High BP | Normal BP |
| | Hyperglycemia | Normal glycemia |
| | Insulin resistance | |
| | Diabetes mellitus | |
| | Obesity | Normal weight |
| | Abdominal fat | Low-calorie diet |
| | Metabolic syndrome | |
| | Dyslipidemia | Normal lipids |
| | Chronic kidney disease | |
| | High-salt diet | Low-salt diet |
| | Smoking | No smoking |
| | Lack of physical activity | Intense physical activity |

| | Additional CV risk factors | |
|---|---|---|
| | Oxidative stress | Insensitivity to oxidative stress |
| | | Strong protective metabolic mechanisms |
| | Alcohol consumption | None of these risk factors |
| | Chronic low-grade inflammation | |
| | Gut microbiome composition | |
| | Social deprivation | |
| | High perceived stress | |
| | Abnormal sleep pattern | |
| | Thrombogenic factors | |
| | Hormonal status | |
| | … | |

*Hypertension*. 2019;74:218-228.

Broad dietary patterns and specific foods that modulate arterial function with aging.

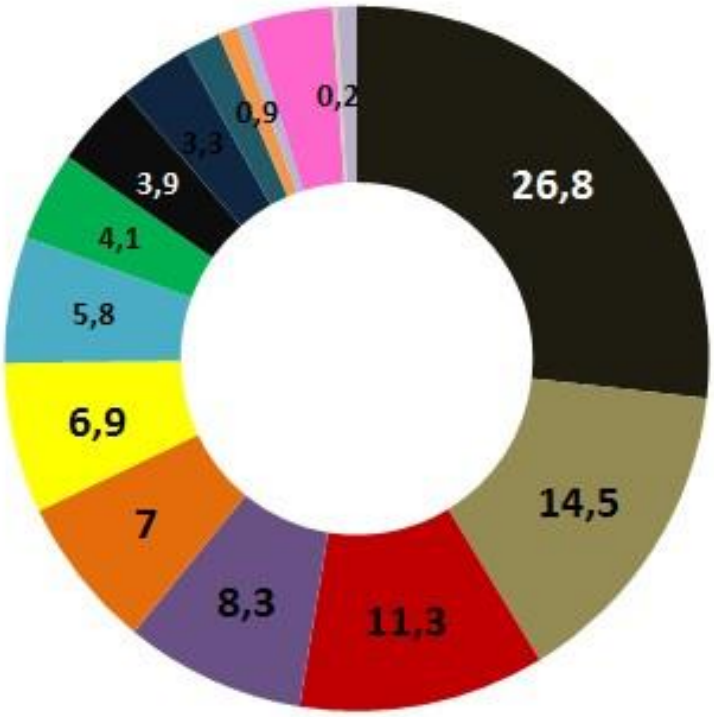


| Diet/factor | Effects | Evidence* |
|---|---|---|
|  Mediterranean, DASH, vegetarian(?) diets | ↑ endothelial function<br>↓ arterial stiffness |  |
|  Higher fruit/vegetable intake | ↑ endothelial function<br>↓ arterial stiffness |  |
|  Higher fish intake | ↑ endothelial function<br>↓ arterial stiffness |  |
|  High fat diet | ↓ endothelial function<br>? arterial stiffness |  |
|  Low fat diet | ↑ endothelial function<br>? arterial stiffness |  |
|  Specific electrolytes | ↑ endothelial function<br>↓ arterial stiffness<br>(some) |  |
|  Sodium restriction | ↑ endothelial function<br>↓ arterial stiffness |  |
|  Nuts, tea, coffee, cocoa, whole grains, legumes, olive oil | ↑ endothelial function<br>↓ arterial stiffness<br>(some) |  |

# Take home messages
# Evidence that salt is bad for you

# Contributions moyennes des groupes d'aliments (en %) aux apports en sodium chez les adultes

Quoidansmonassiette.fr
Etude INCA2




- Pain, céréales
- Condiments sauces, soupes, bouillons
- Charcuteries
- Plats composés
- Pizza, quiches, sandwichs
- Fromages
- Viennoiseries, biscuits, pâtisseries
- Légumes et légumes secs
- Viande, vollaille, abat, œufs
- Lait, produits laitiers, crèmes desserts
- Boissons, eau
- Chocolat, sucre, café, glace
- Matières grasses
- Poissons, crustacés

¾ apports

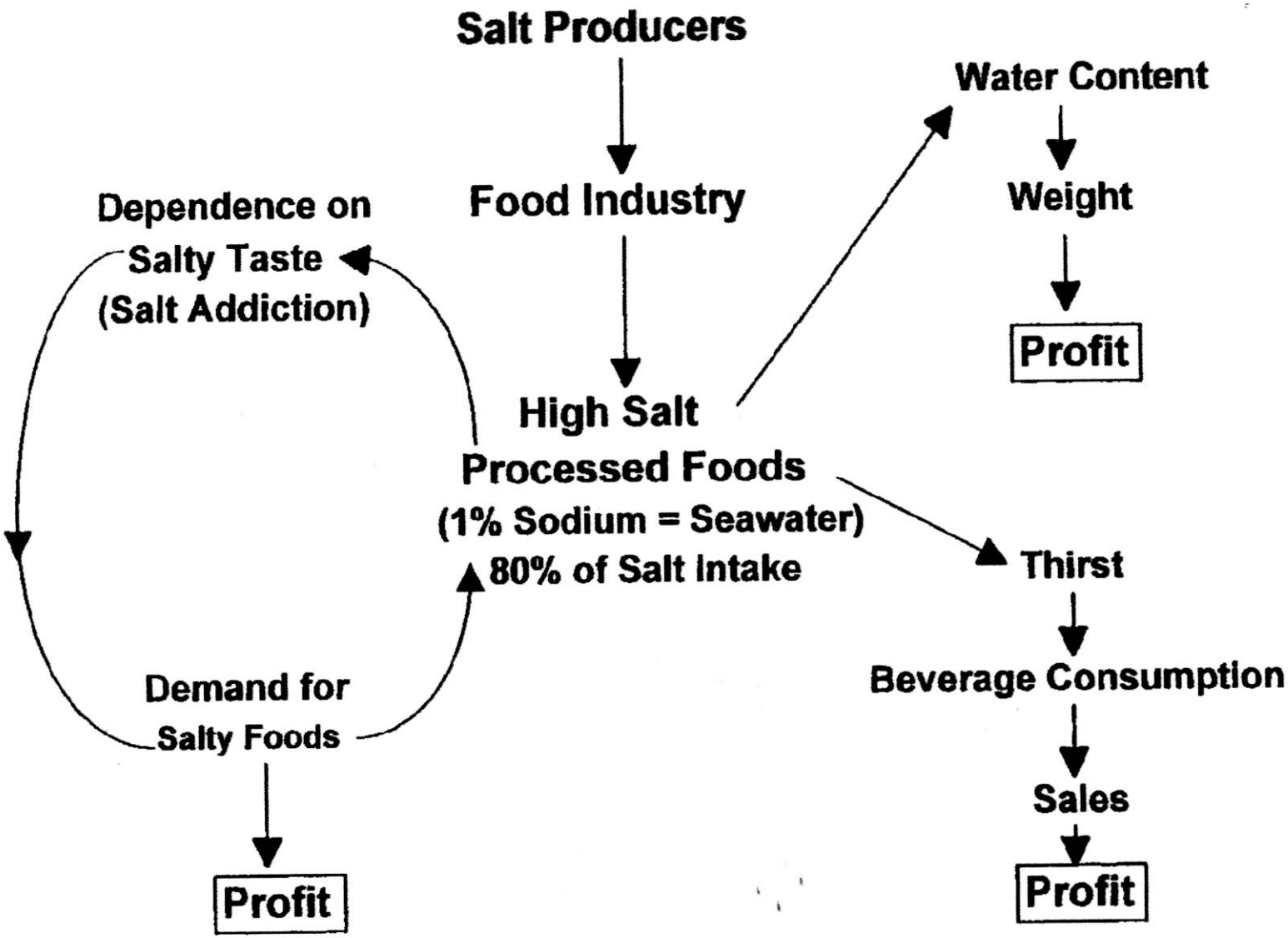



**Fig. 5.** The commercial importance of salt in processed food.

## Table 1 | UK strategy for reducing salt

| Source | Salt intake g/day | Reduction needed | Target intake (g/day) |
|---|---|---|---|
| Table/cooking (15%) | 1.4 g | 40% reduction | 0.9 g |
| Natural (5%) | 0.5 g | No reduction | 0.5 g |
| Food industry (80%) | 7.6 g | 40% reduction | 4.6 g |
| | Total: 9.5 g | | Target: 6.0 g |

*Kidney International* (2010) **78**, 745–753;

# FDA Sodium Reduction Targets and the Food Industry: Are There Incentives to Reformulate? Microsimulation Cost-Effectiveness Analysis

The World Health Organization has recommended sodium reduction as a "best buy" to prevent cardiovascular disease (CVD). Despite this, Congress has temporarily blocked the US Food and Drug Administration (FDA) from implementing voluntary industry targets for sodium reduction in processed foods, the implementation of which could cost the industry around $16 billion over 10 years.

The Milbank Quarterly, Vol. 00, No. 00, 2019 (pp. 1-23)


National Salt Awareness Week

11th - 17th March 2013

www.actiononsalt.org.uk

CASH

Merci de votre attention