A megfelelő nátriumbevitel szerepe egészséges és beteg szervezetben

Agócs Róbert István

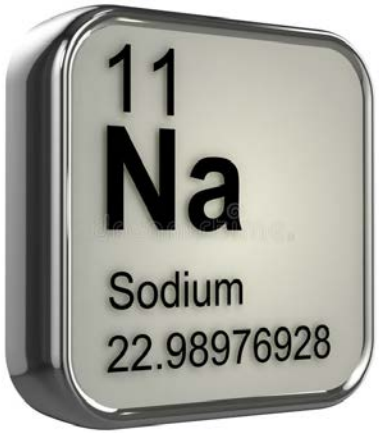
2018.04.14.

VÁZLAT

1. Na^+ a szervezetben
2. Na^+-bevitel, ajánlások
3. Magas/alacsony Na^+ bevitel következményei
4. Na^+ bevitel mérséklése beteg szervezetben
5. Na^+ bevitel lehetséges szerepe egyéb betegségekben (Na^+ immunmoduláns hatása)
6. Sószegény diéta kialakítása

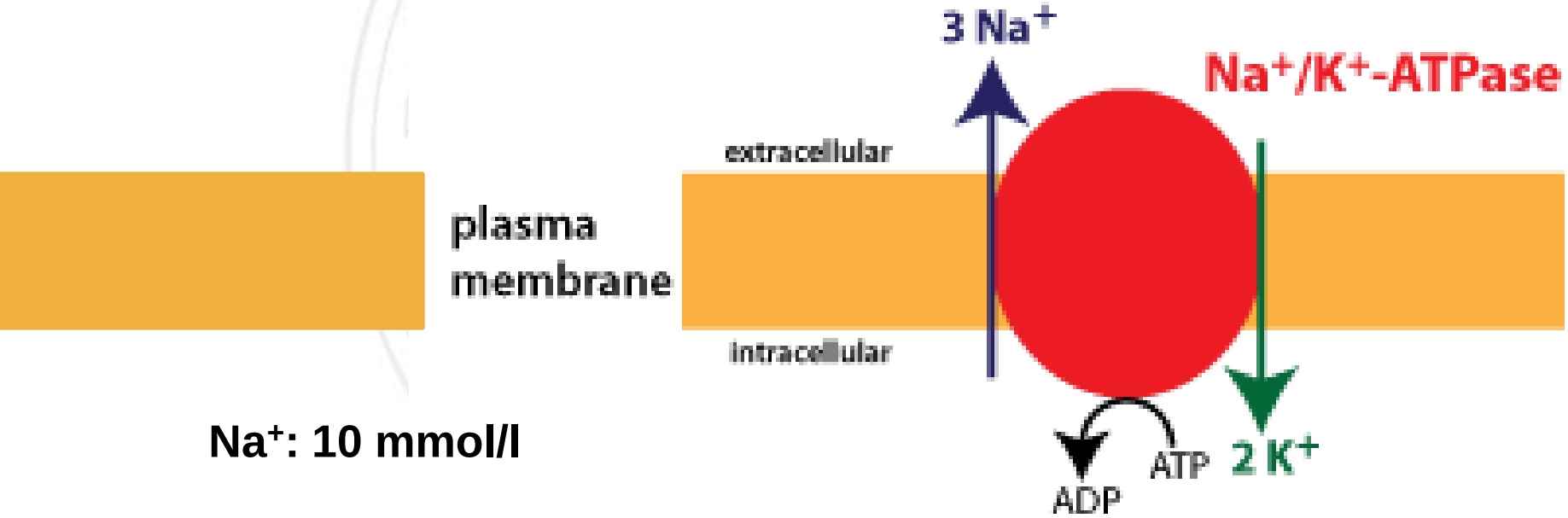
Na^+ a szervezetben

- Extracelluláris tér meghatározó kationja
  - Szérum ozmolalitás



Ozm.: ~290 mOsm/kg

Na^+: 140 mmol/l

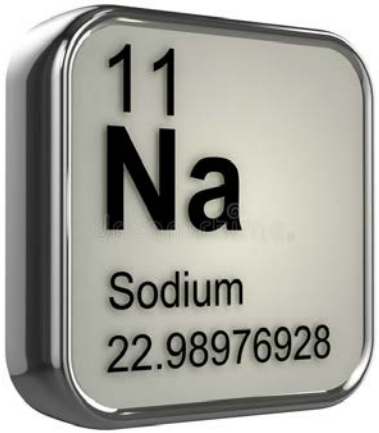


Na^+: 10 mmol/l

Ozm.: ~290 mOsm/kg

Na^+ a szervezetben

- Élettani szerepe:
  - **ECV és vérnyomás fenntartása**
  - Ideg- és izomműködés
  - Exocrin mirigyek működése



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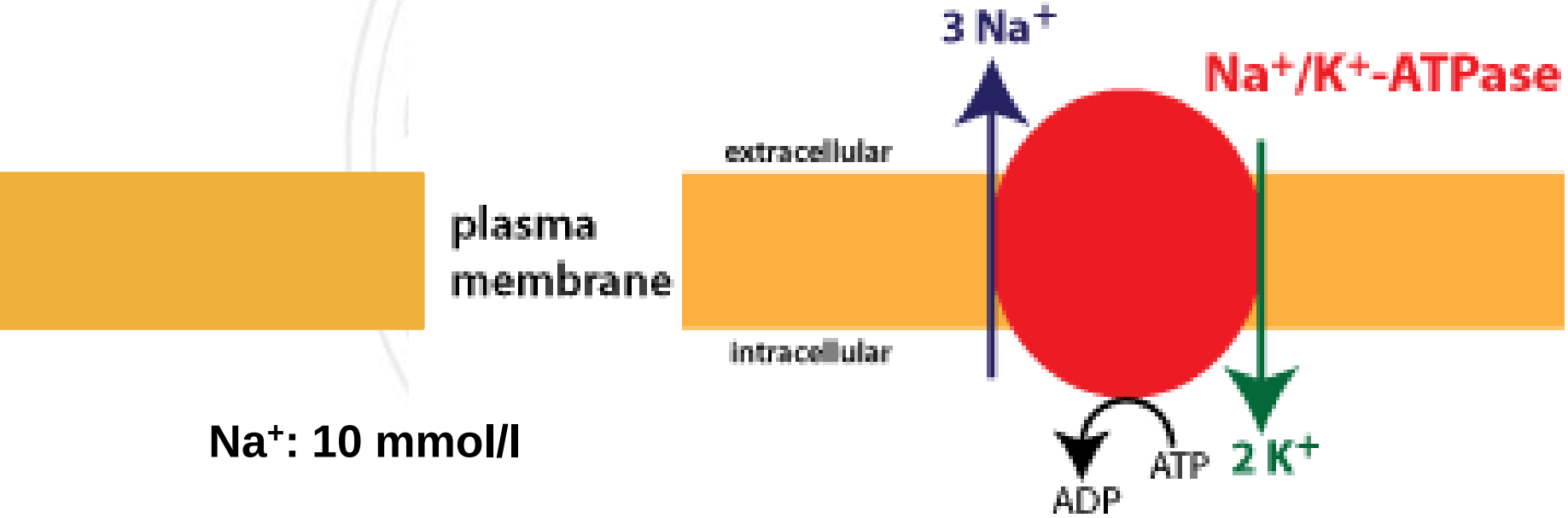
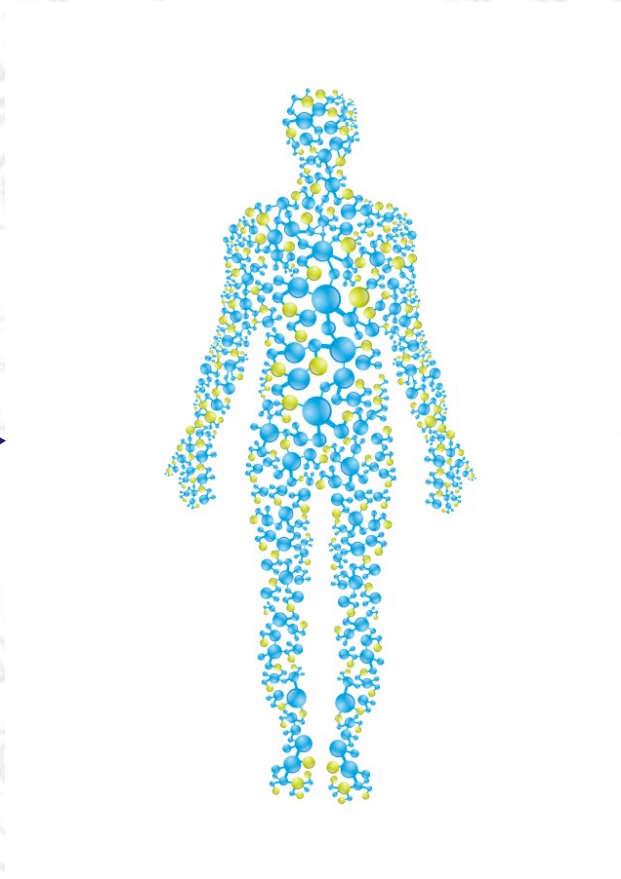


Na^+: 10 mmol/l

Ozm.: ~290 mOsm/kg

Na^+ homeosztázis

Na^+-bevitel



Na^+-ürítés

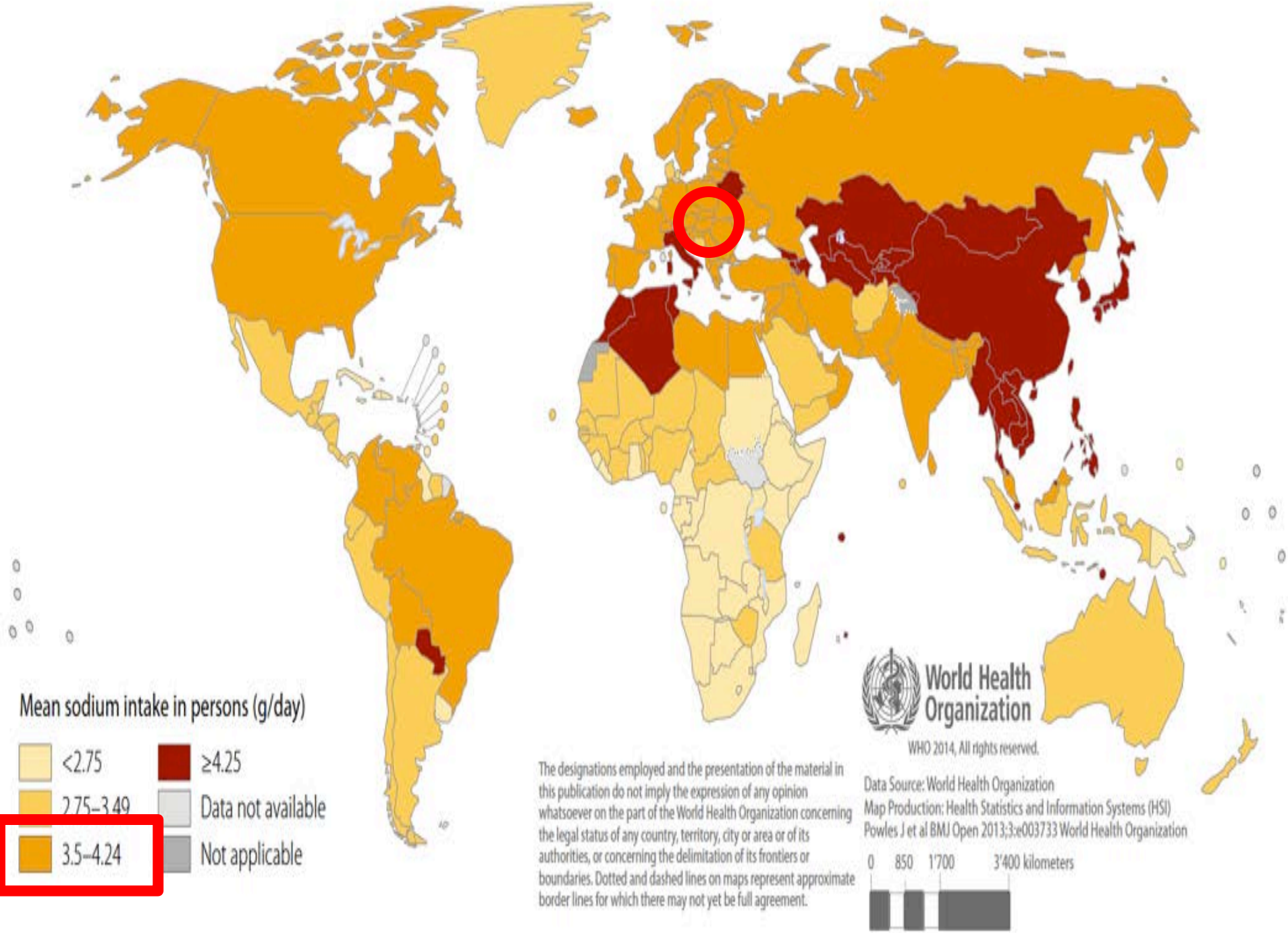
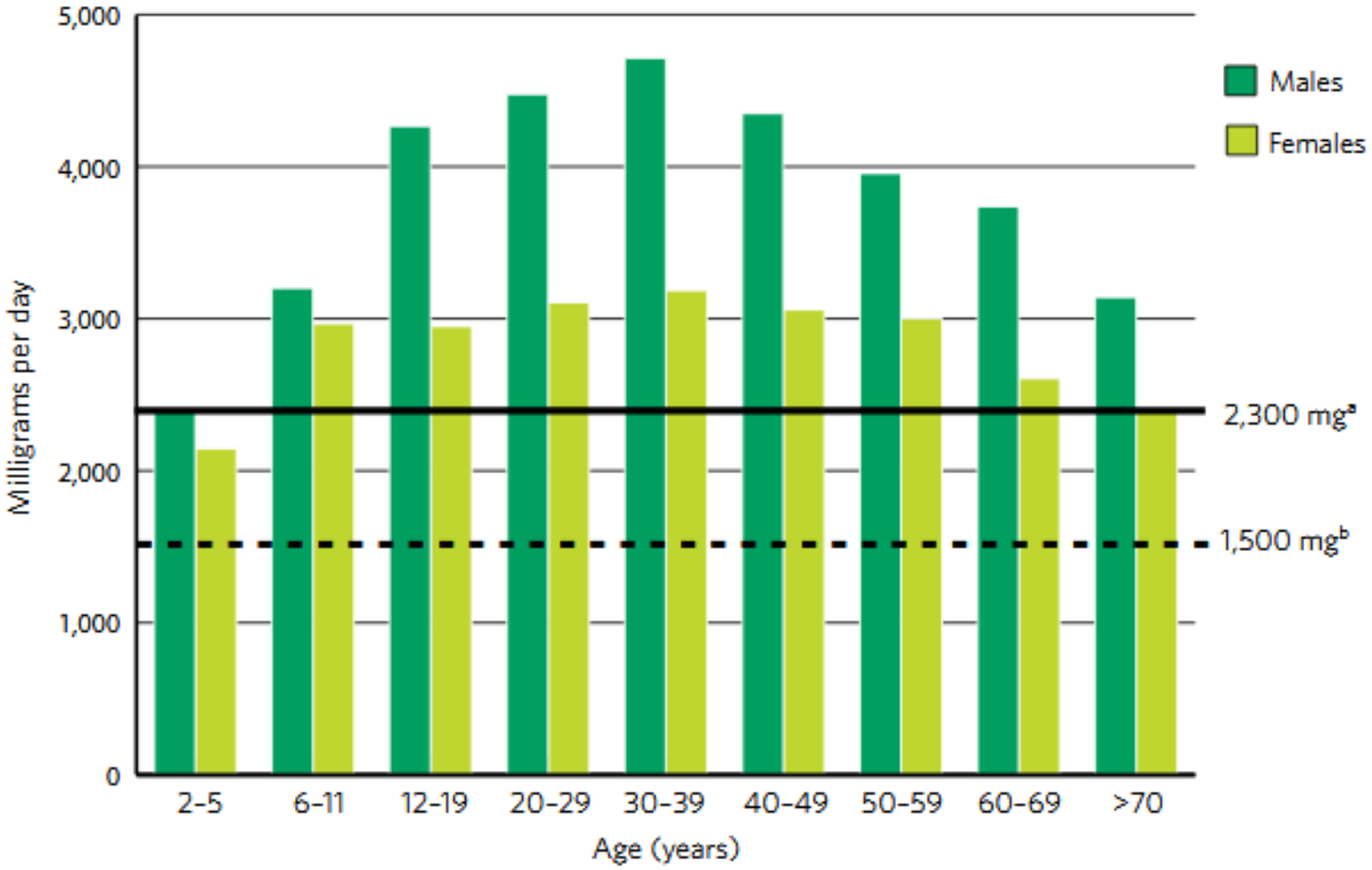
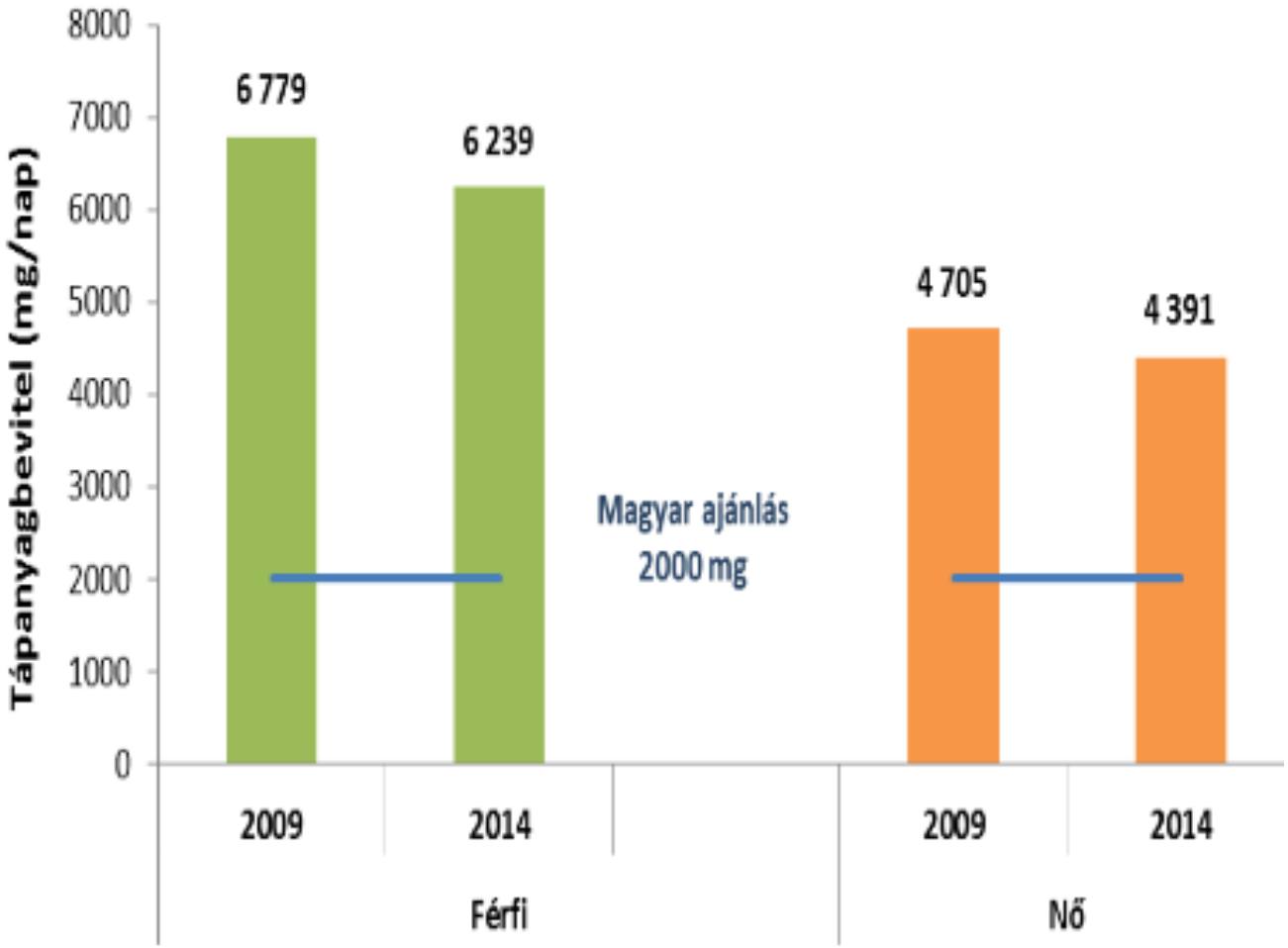

Mean sodium intake in persons (g/day)
<2.75
2.75–3.49
3.5–4.24
≥4.25
Data not available
Not applicable
World Health Organization
WHO 2014, All rights reserved.
The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.
Data Source: World Health Organization
Map Production: Health Statistics and Information Systems (HSI)
Powles J et al BMJ Open 2013;3:e003733 World Health Organization
0 850 1'700 3'400 kilometers

FIGURE 3-1. Estimated Mean Daily Sodium Intake, by Age–Gender Group, NHANES 2005–2006



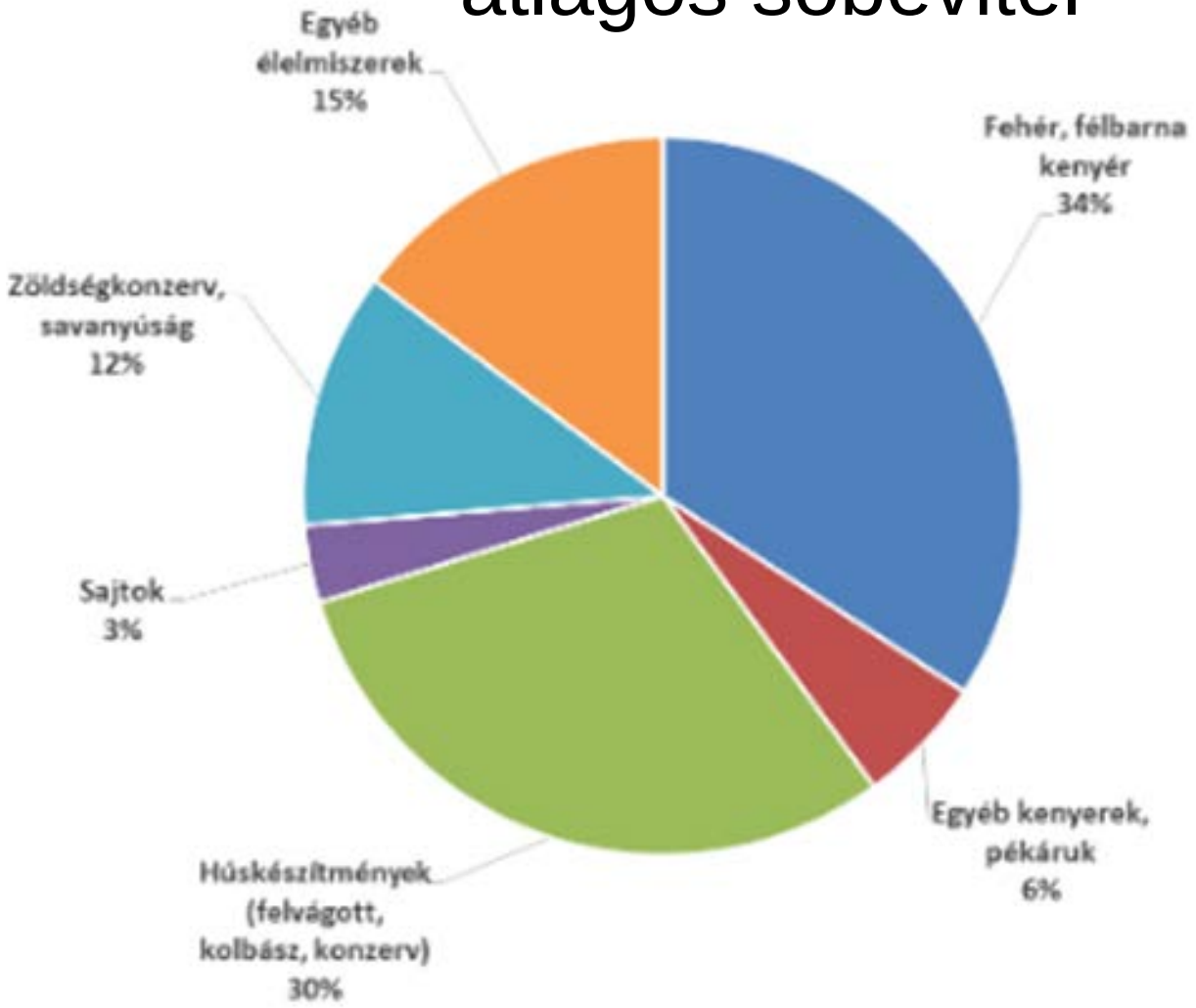
OTÁP 2014

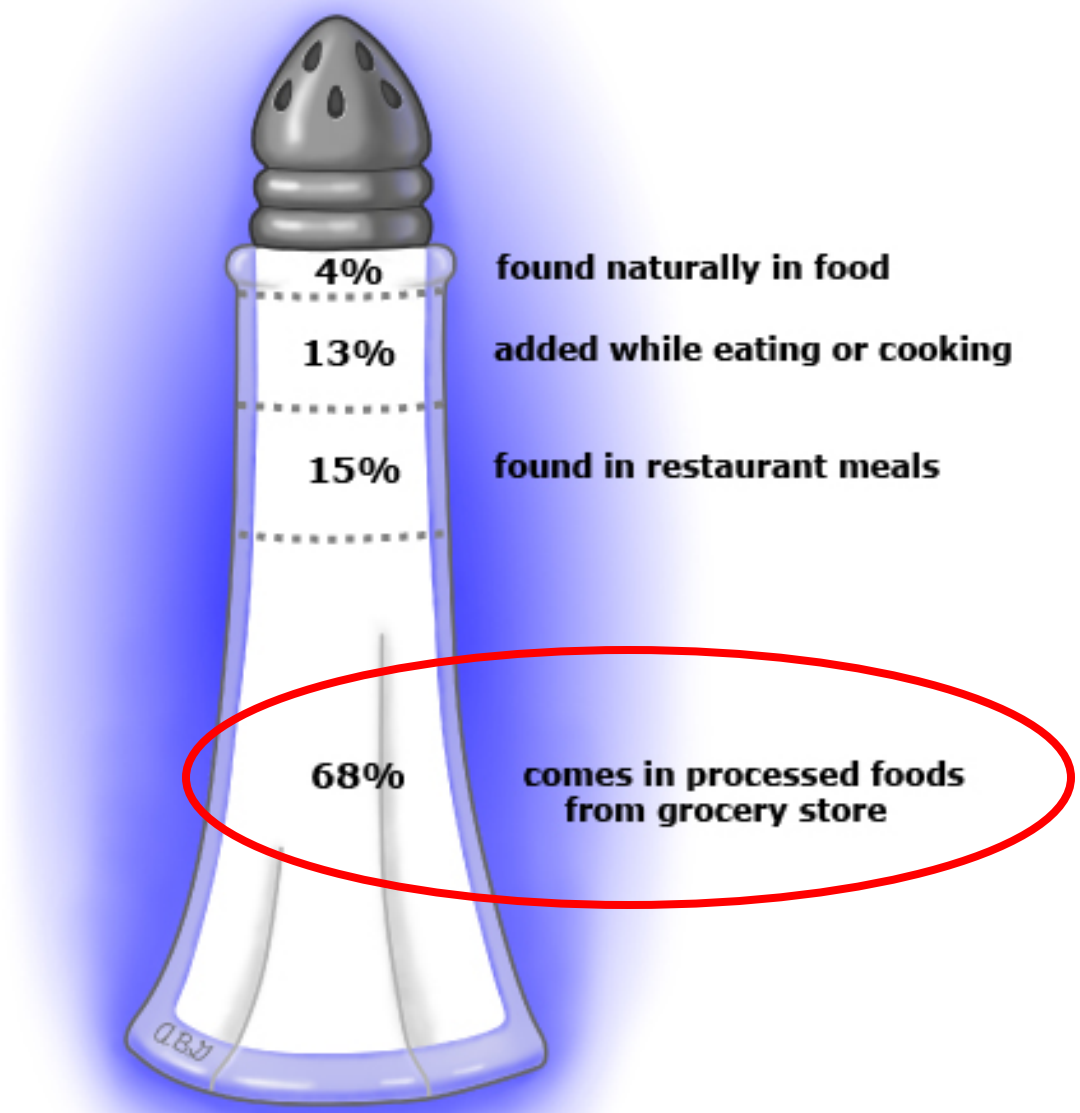

Tápanyagbevitel (mg/nap)
8000
7000
6000
5000
4000
3000
2000
1000
0
6 779
6 239
4 705
4 391
Magyar ajánlás
2000 mg
2009
2014
2009
2014
Férfi
Nő

Forrás

- **NaCl (konyhasó)**
- Nátrium-bikarbonát (szódabikarbóna)
- Nátrium-glutamát (ízfokozó)

Feldolgozott élelmiszerekből származó napi átlagos sóbevitel



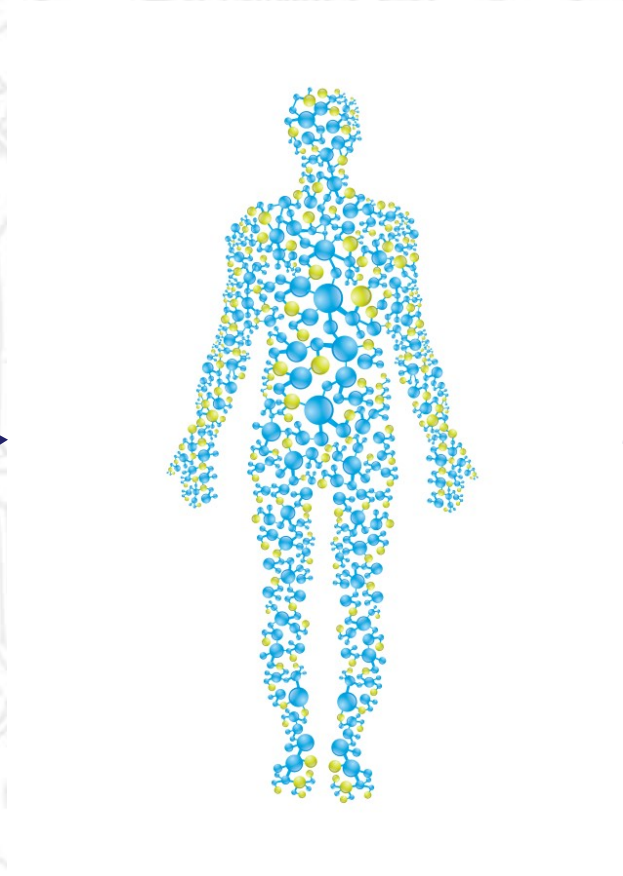

4%
found naturally in food
13%
added while eating or cooking
15%
found in restaurant meals
68%
comes in processed foods
from grocery store

Új koncepciók

Pozitív Na^+

egyensúly

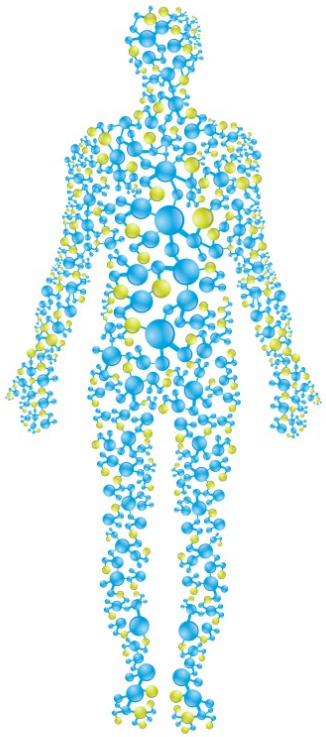
Na+-bevitel

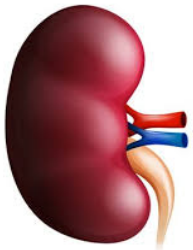


Na+-ürítés

Na^+-tárolás a bőrben

Na^+-bevitel





Na^+-ürítés

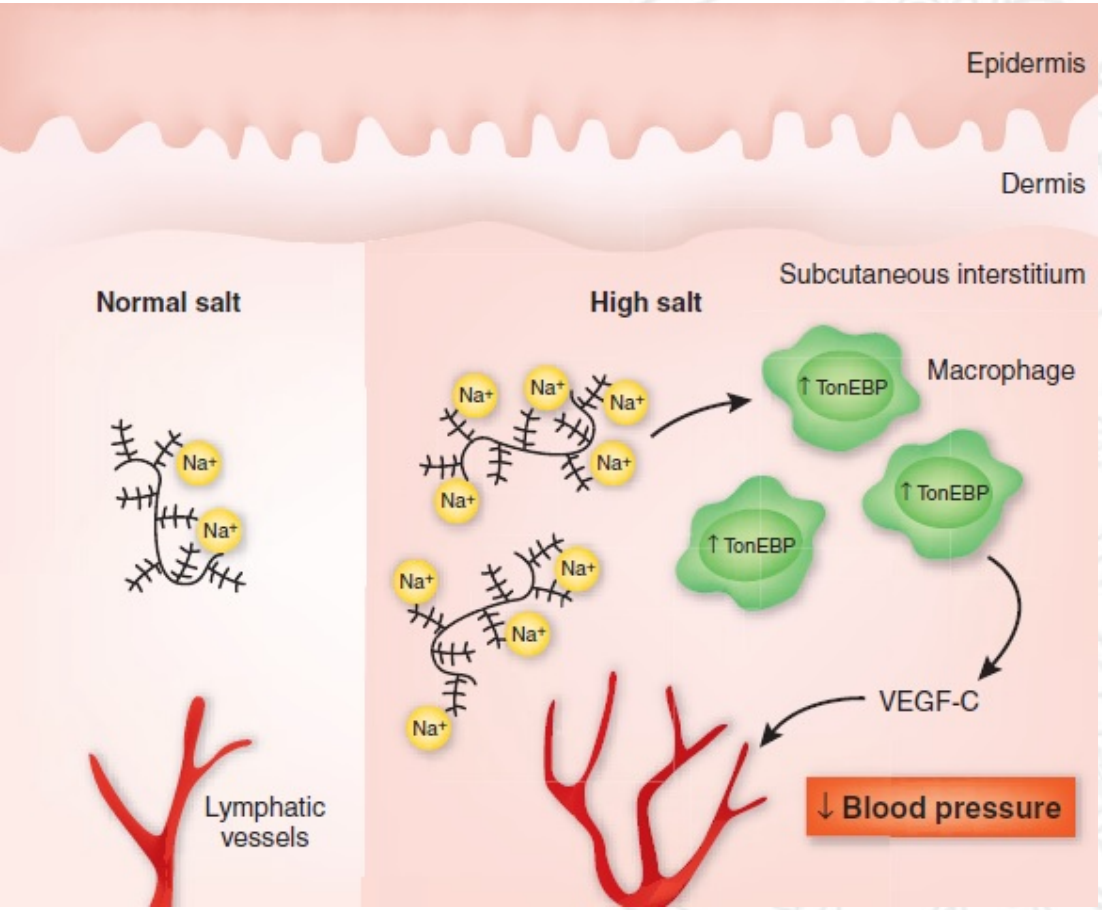
Na^+-tárolás

ARTICLES

nature medicine

Macrophages regulate salt-dependent volume and blood pressure by a vascular endothelial growth factor-C–dependent buffering mechanism

Agnes Machnik[1], Wolfgang Neuhofer[2], Jonathan Jantsch[1,3], Anke Dahlmann[1], Tuomas Tammela[4], Katharina Machura[5], Joon-Keun Park[6], Franz-Xaver Beck[2], Dominik N Müller[7], Wolfgang Derer[8], Jennifer Goss[1], Agata Ziomber[1], Peter Dietsch[9], Hubertus Wagner[10], Nico van Rooijen[11], Armin Kurtz[5], Karl F Hilgers[1], Kari Alitalo[4], Kai-Uwe Eckardt[1], Friedrich C Luft[7,8], Dontscho Kerjaschki[12] & Jens Titze[1]



- Na^+ bevitel
- GAG - Na^+ kötés
- Lokális hipertonicitás
- Monocyta/Macrophag aktiváció
- TonEBP transzaktiváció
- VEGF-C szekréció
- Nyirokérhálózat ↑
  RR ↓

Nat Med. 2009 May;15(5):545-52. doi: 10.1038/nm.1960. Epub 2009 May 3.

Ajánlások

<2000-2300 mg Na^+/nap

World Health Organization

American Diabetes Association®

American Heart Association

KIDNEY DISEASE · IMPROVING GLOBAL OUTCOMES KDIGO®

eat right.® Academy of Nutrition and Dietetics

USDA United States Department of Agriculture

OGYÉI
Országos Gyógyszerészeti és Élelmezés-egészségügyi Intézet

World Health Organization

Guideline:

Sodium intake for adults and children

2012

World Health Organization

Recommendations

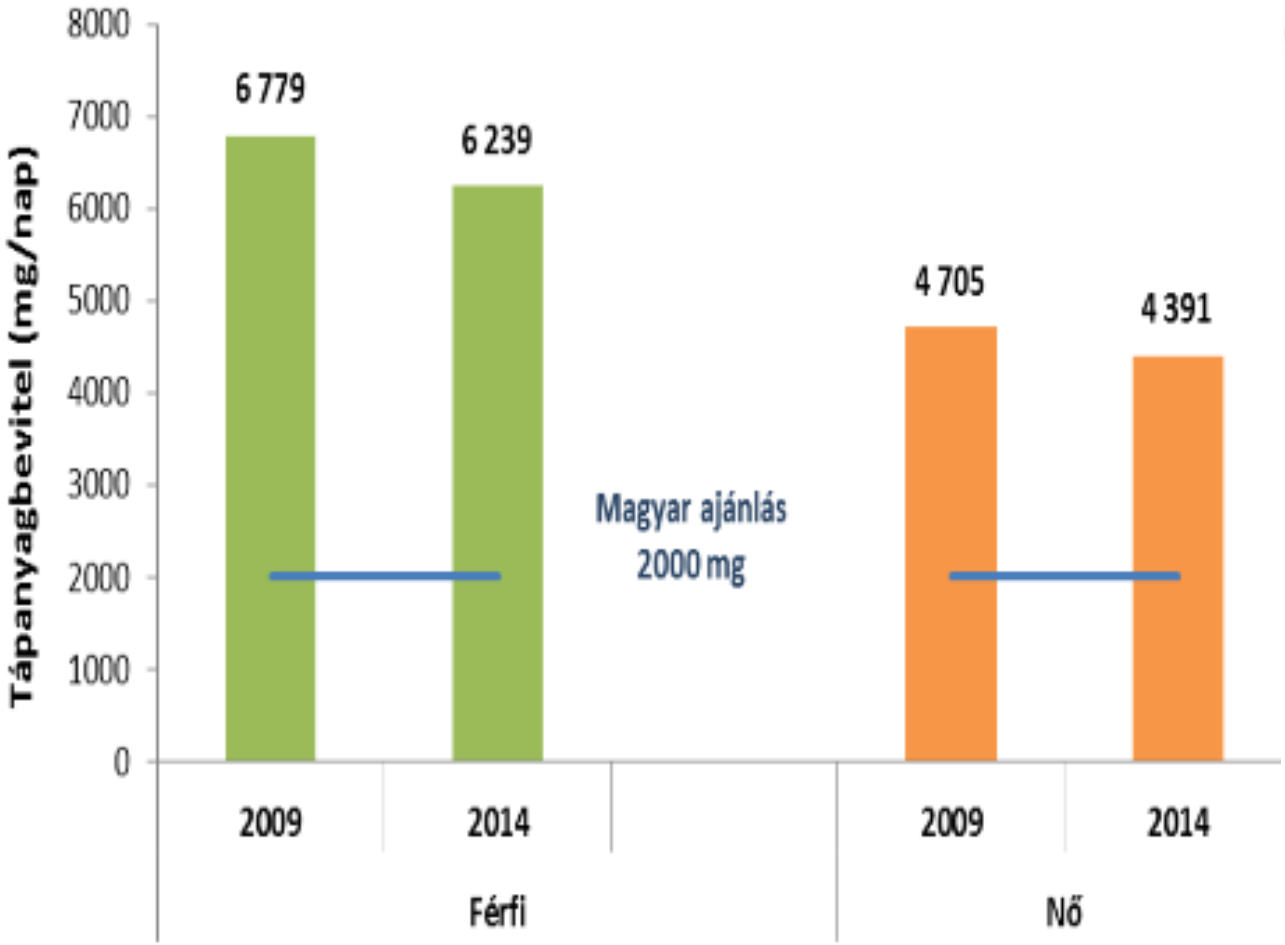
- WHO recommends a reduction in sodium intake to reduce blood pressure and risk of cardiovascular disease, stroke and coronary heart disease in adults (*strong recommendation* [1]). WHO recommends a reduction to <2 g/day sodium (5 g/day salt) in adults (*strong recommendation*).
- WHO recommends a reduction in sodium intake to control[2] blood pressure in children (strong recommendation). The recommended maximum level of intake of 2 g/day sodium in adults should be adjusted downward based on the energy requirements of children relative to those of adults.

World Health Organization

Remarks

- These recommendations apply to all individuals, with or without hypertension (including pregnant or lactating women), except for individuals with illnesses or taking drug therapy that may lead to hyponatraemia or acute build-up of body water, or require physician-supervised diets (e.g. patients with heart failure and those with type I diabetes). In these subpopulations, there may be a particular relationship between sodium intake and the health outcomes of interest (*10, 11*). Hence, these subpopulations were not considered in the review of the evidence and generation of the guideline.
- For this recommendation, "adults" includes individuals ≥16 years of age.
- For this recommendation, "children" includes individuals 2–15 years of age inclusive.

OTÁP 2014


Tápanyagbevitel (mg/nap)
8000
7000
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4000
3000
2000
1000
0
6 779
6 239
4 705
4 391
Magyar ajánlás
2000 mg
2009
2014
2009
2014
Férfi
Nő

Ajánlások gyermekkorban

USDA

Scientific Report of the
2015 Dietary Guidelines Advisory Committee

Advisory Report to the Secretary of Health and Human Services
and the Secretary of Agriculture

INSTITUTE OF MEDICINE
OF THE NATIONAL ACADEMIES

Kor	Megengedett max. bevitel
1-3 év	1000 mg/nap
4-8 év	1200 mg/nap
9-13 év	1500 mg/nap
14-18 év	**2300 mg/nap**

Magas Na^+ bevitel következményei

- **Magas vérnyomás**
- Csontritkulás
- Vesekő-képződés
- (Gyomorrák)

Magas vérnyomás

- Nátriumbevitel ↑ → ECV ↑

NaCl

Magas vérnyomás

CV betegség

BMJ

BMJ 2013;346:f1325 doi: 10.1136/bmj.f1325 (Published 5 April 2013)

Effect of longer term modest salt reduction on blood pressure: Cochrane systematic review and meta-analysis of randomised trials

OPEN ACCESS

Feng J He *senior research fellow*[1], Jiafu Li *professor of medicine*[2], Graham A MacGregor *professor of cardiovascular medicine*[1]

34 randomizált, kontrollált vizsgálat (3230 beteg):

min. 4 hét

~-1,76 g Na^+/nap csökkentés

BMJ

BMJ 2013;346:f1325 doi: 10.1136/bmj.f1325 (Published 5 April 2013)

Effect of longer term modest salt reduction on blood pressure: Cochrane systematic review and meta-analysis of randomised trials

OPEN ACCESS

Feng J He *senior research fellow*[1], Jiafu Li *professor of medicine*[2], Graham A MacGregor *professor of cardiovascular medicine*[1]

	Normotenzív	Hipertenzív
Szisztolés	**−2.42 mmHg** (−3.56 to −1.29)	**−5.39 mmHg** (−6.62 to −4.15)
Diasztolés	**−1.00 mmHg** (−1.85 to −0.15)	**−2.82 mmHg** (−3.54 to −2.11)

BMJ

BMJ 2013;346:f1325 doi: 10.1136/bmj.f1325 (Published 5 April 2013)

Effect of longer term modest salt reduction on blood pressure: Cochrane systematic review and meta-analysis of randomised trials

OPEN ACCESS

Feng J He *senior research fellow*[1], Jiafu Li *professor of medicine*[2], Graham A MacGregor *professor of cardiovascular medicine*[1]

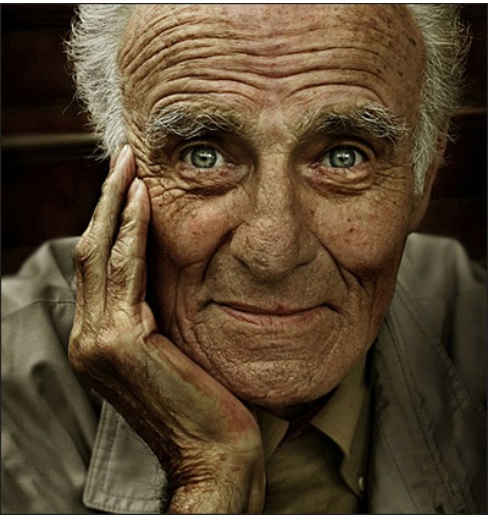
Dózis-függés

Egyéni különbségek

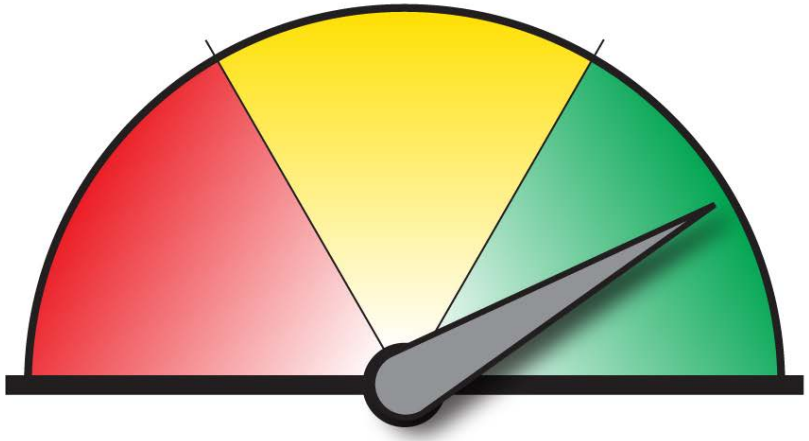
Sószenzitivitás

Egyéni különbségek

- Genetikai faktorok (rassz)
- Életkor
- Környezeti faktorok (pl. táplálkozás, túlsúly)
- Egyéb betegségek (pl. DM, veseelégtelenség)



Só-szenzitív



Só-rezisztens

Sószenzitivitás

© 2015 Metodio Design AB | www.metodio.se | Art no: 10112-1

<1500 mg/nap

USDA United States Department of Agriculture

<2300 mg/nap

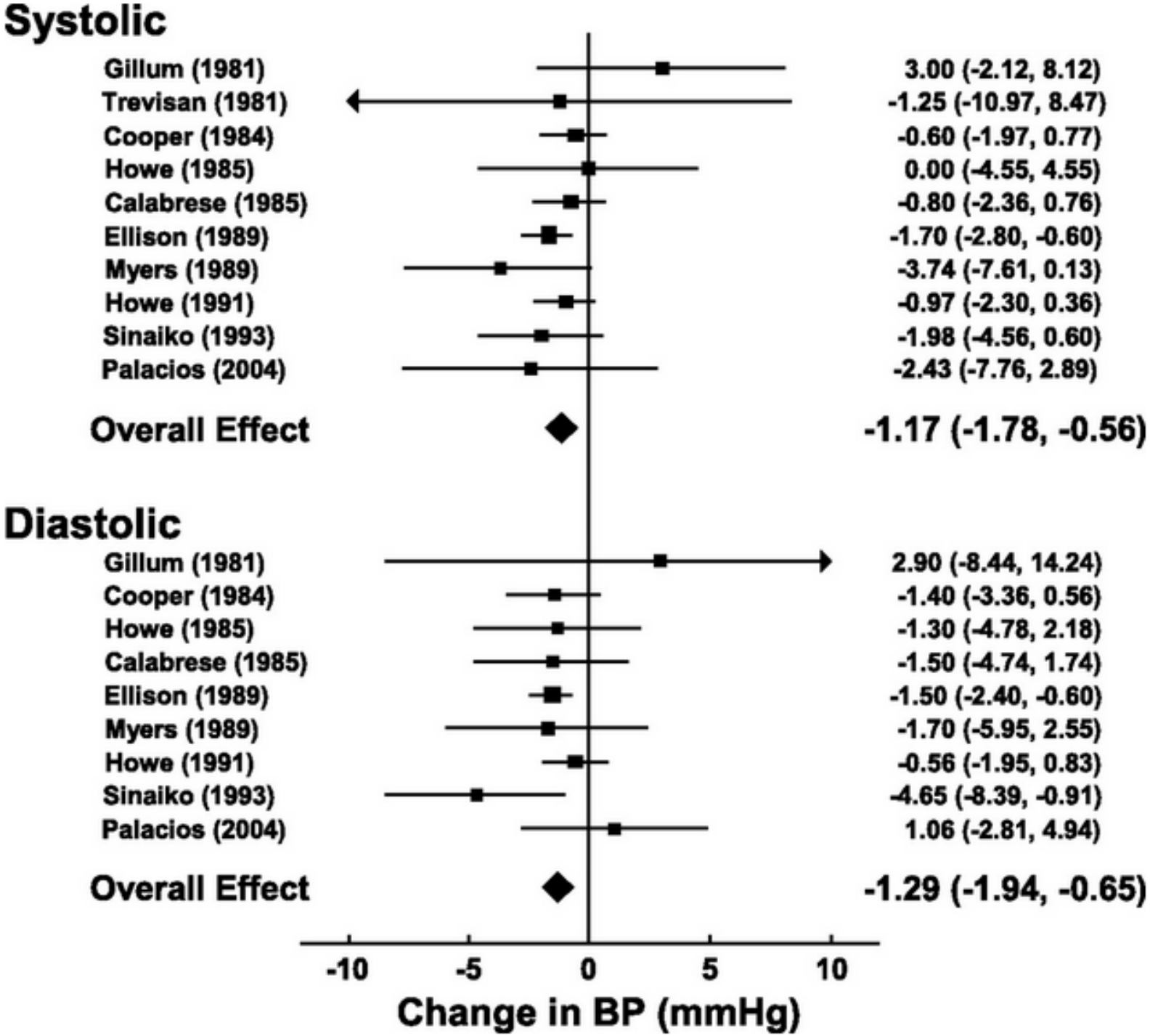
Annals of Internal Medicine | ARTICLE

Effects of Diet and Sodium Intake on Blood Pressure: Subgroup Analysis of the DASH-Sodium Trial

William M. Vollmer, PhD; Frank M. Sacks, MD; Jamy Ard, MD; Lawrence J. Appel, MD; George A. Bray, MD; Denise G. Simons-Morton, MD, PhD; Paul R. Conlin, MD; Laura P. Svetkey, MD; Thomas P. Erlinger, MD; Thomas J. Moore, MD; and Njeri Karanja, PhD, for the DASH-Sodium Trial Collaborative Research Group*

Nem-HT résztvevők:

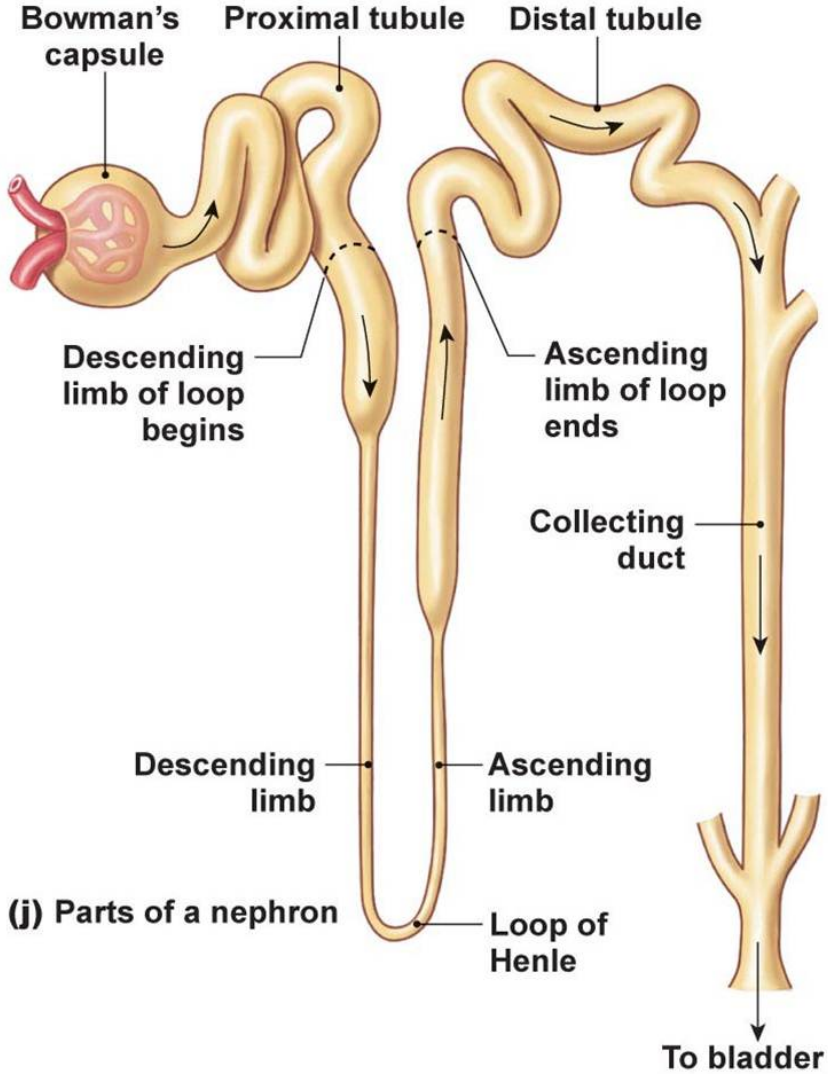
	>45 év	<45 év
Szisztolés	-7,0 mmHg	-3,7 mmHg
Diasztolés	-3,8 mmHg	-1,5 mmHg
	P<0,01	P<0,05


Systolic
Gillum (1981) 3.00 (-2.12, 8.12)
Trevisan (1981) -1.25 (-10.97, 8.47)
Cooper (1984) -0.60 (-1.97, 0.77)
Howe (1985) 0.00 (-4.55, 4.55)
Calabrese (1985) -0.80 (-2.36, 0.76)
Ellison (1989) -1.70 (-2.80, -0.60)
Myers (1989) -3.74 (-7.61, 0.13)
Howe (1991) -0.97 (-2.30, 0.36)
Sinaiko (1993) -1.98 (-4.56, 0.60)
Palacios (2004) -2.43 (-7.76, 2.89)
Overall Effect -1.17 (-1.78, -0.56)
Diastolic
Gillum (1981) 2.90 (-8.44, 14.24)
Cooper (1984) -1.40 (-3.36, 0.56)
Howe (1985) -1.30 (-4.78, 2.18)
Calabrese (1985) -1.50 (-4.74, 1.74)
Ellison (1989) -1.50 (-2.40, -0.60)
Myers (1989) -1.70 (-5.95, 2.55)
Howe (1991) -0.56 (-1.95, 0.83)
Sinaiko (1993) -4.65 (-8.39, -0.91)
Palacios (2004) 1.06 (-2.81, 4.94)
Overall Effect -1.29 (-1.94, -0.65)
-10
-5
0
5
10
Change in BP (mmHg)

N=966

8-16 év

Fokozott kálcium-ürítés



Flow-dependens calciuria

- Na+ bevitel +100 mmol (2,3g)
- Ca2+ ürítés +1,4 mmol

- **Osteoporosis**
- Vesekőképződés (?)

→ Ca2+ ↑

Alacsony Na^+ bevitel következményei

- **LDL, TG ↑**
- **Insulin resistance ↑**
- **Hyponatremia:** meleg környezet, idősek, sportolók

Na^+-bevitel csökkentése egyes betegségekben

- HT
- **Szívelégtelenség**
- **Vesebetegség**
- **Májcirrhosis - Ascites**

Na+ bevitel ↓

↓

Folyadékretenció ↓

↓

Antihipertenzív terápia
Ödéma kontroll

↓

Tünetek és prognózis javulhat

Szívelégtelenség

American Heart Association

- A és B: <1500 mg/nap
- C és D: Nincs ajánlás. (<3000mg/nap)

Veseelégtelenség

Na+ bevitel ↓

↓

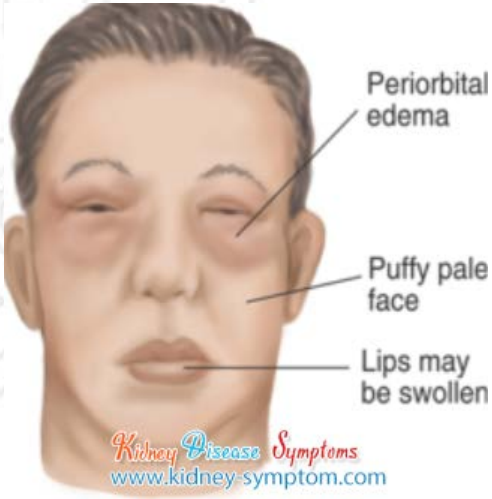
Folyadékretenció ↓

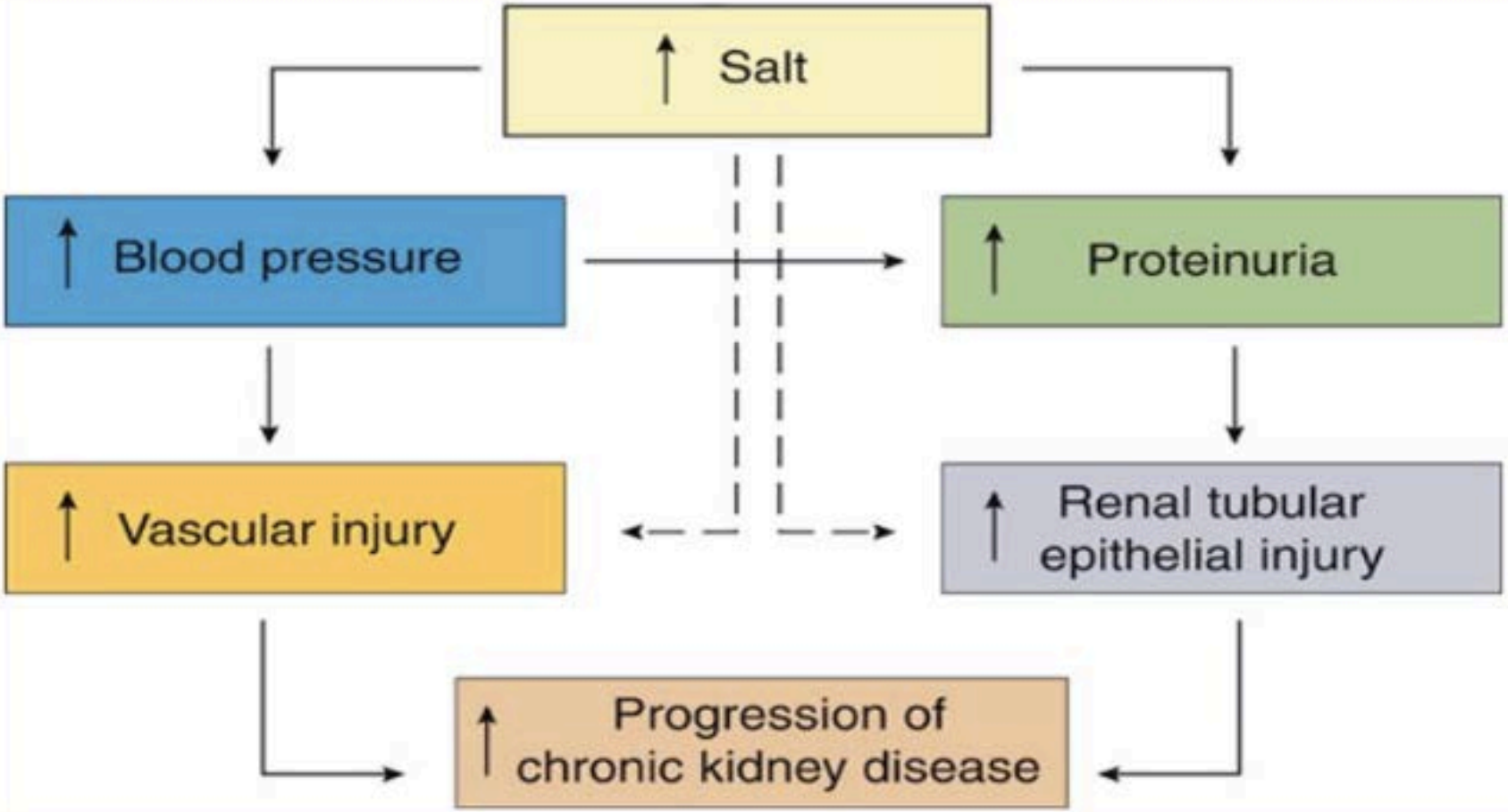
↓

Antihipertenzív terápia
Ödéma kontroll

↓

Tünetek és prognózis javulhat




↑ Salt
↑ Blood pressure
↑ Proteinuria
↑ Vascular injury
↑ Renal tubular epithelial injury
↑ Progression of chronic kidney disease

Moderate dietary sodium restriction added to angiotensin converting enzyme inhibition compared with dual blockade in lowering proteinuria and blood pressure: randomised controlled trial

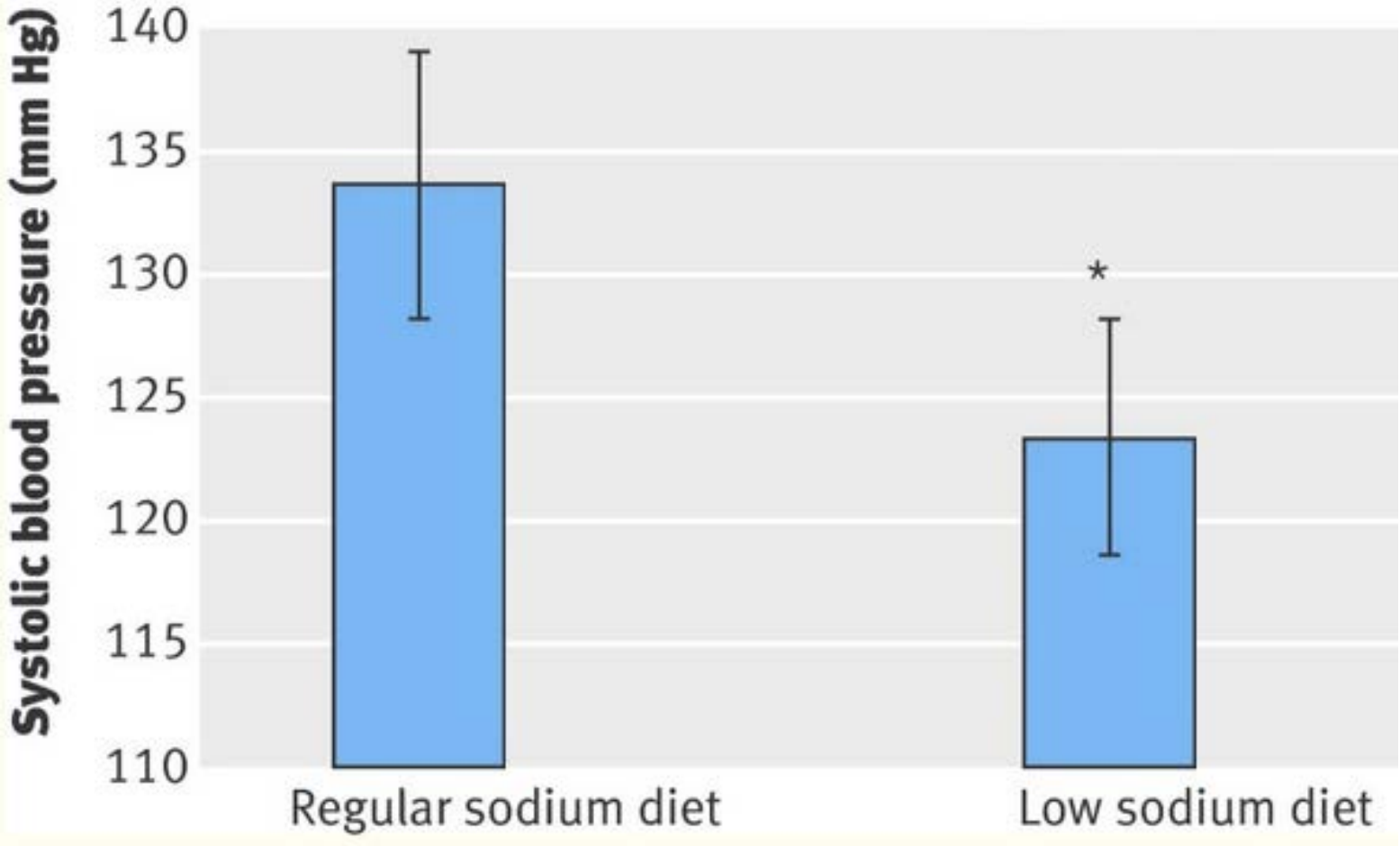
thebmj

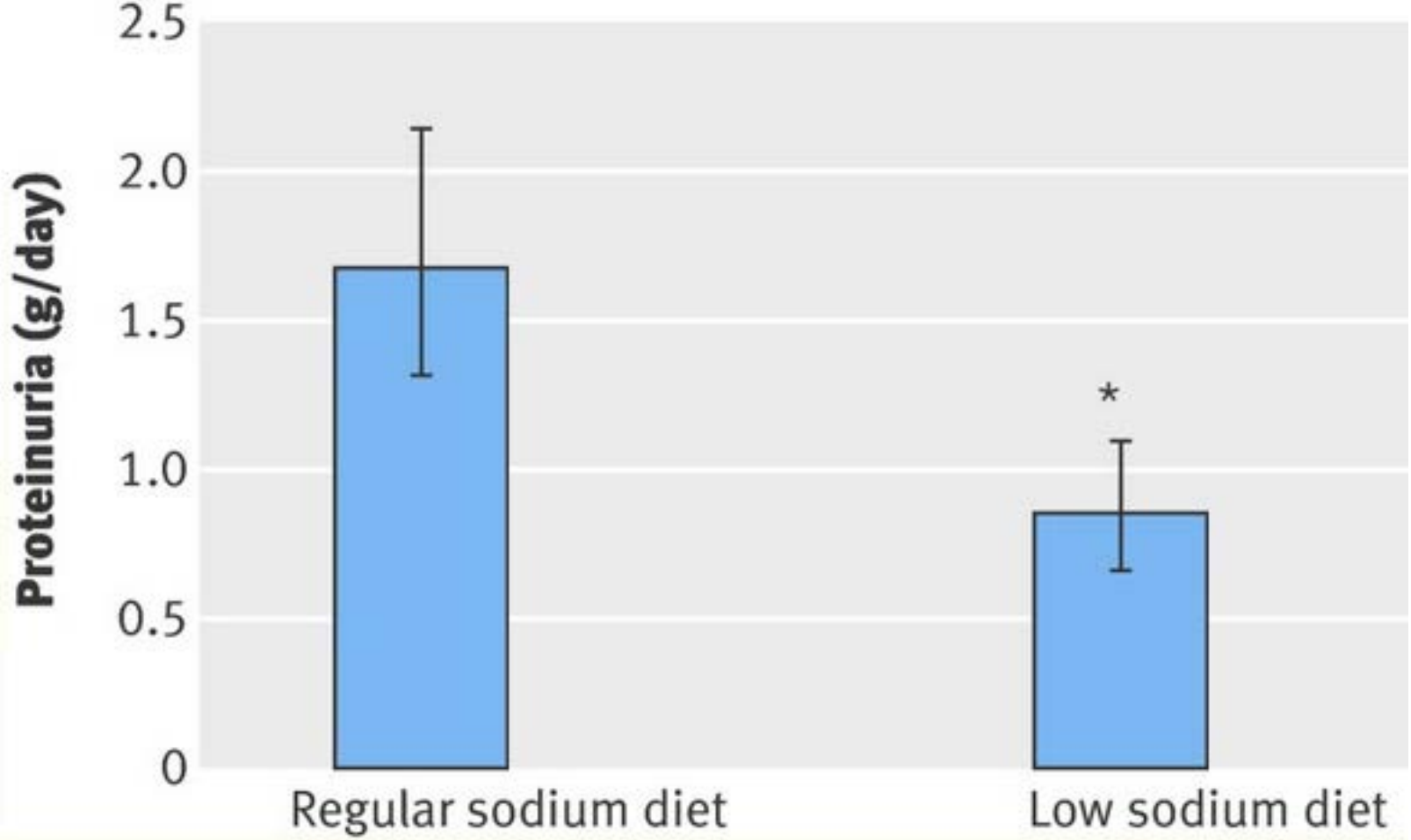
52 beteg:

- Nem-DM nephropathia
- >125/75 mmHg
- >1,0 g protein/nap
- Lisinopril 40 mg/nap
- >30 ml/min GFR
- >18 év

1200 mg Na^+/nap

4800 mg Na^+/nap


Systolic blood pressure (mm Hg)
140
135
130
125
120
115
110
*
Regular sodium diet
Low sodium diet


Proteinuria (g/day)
2.5
2.0
1.5
1.0
0.5
0
*
Regular sodium diet
Low sodium diet

Ascites

AASLD
PRACTICE GUIDELINE

Management of Adult Patients with Ascites Due to Cirrhosis: Update 2012

Treatment

1. Discontinue alcohol and consider baclofen treatment
2. Discontinue medications that decrease renal perfusion (ie, NSAIDs, beta-blockers, ACEs, ARBs)
3. Treat underlying liver disease when possible
4. Dietary education; 2 g (88 mmol) per day sodium-restricted diet
5. Diuretics:
   - Spironolactone 100 mg per day plus oral furosemide 40 mg per day given in the morning as a single daily dose
   - Titrate doses upward as needed at intervals of ≥3 to 5 days
   - When titrating doses, maintain a ratio of 100 mg spironolactone to 40 mg furosemide
   - Usual maximum daily doses: 400 mg spironolactone and 160 mg oral furosemide
   - In small patients with a small volume of ascites, start with lower doses (eg, spironolactone 50 mg per day plus oral furosemide 20 mg per day)

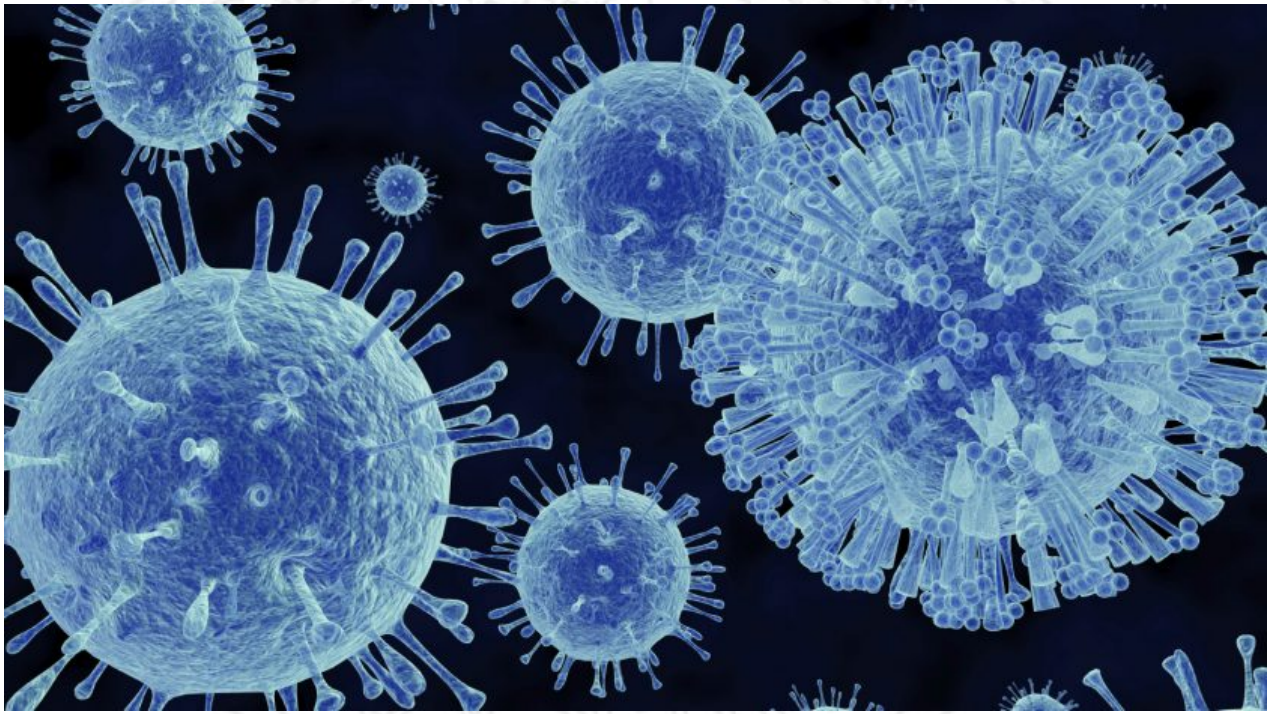
EXPERT REVIEWS

Management of ascites in children

Expert Rev. Gastroenterol. Hepatol. 9(10), 1281–1292 (2015)

- Kisgyermekkor:
  - 1-2 mmol/kg/nap (0,023-0,046 g Na^+/kg/nap)
- Serdülőkor:
  - 1-2 g Na^+/nap

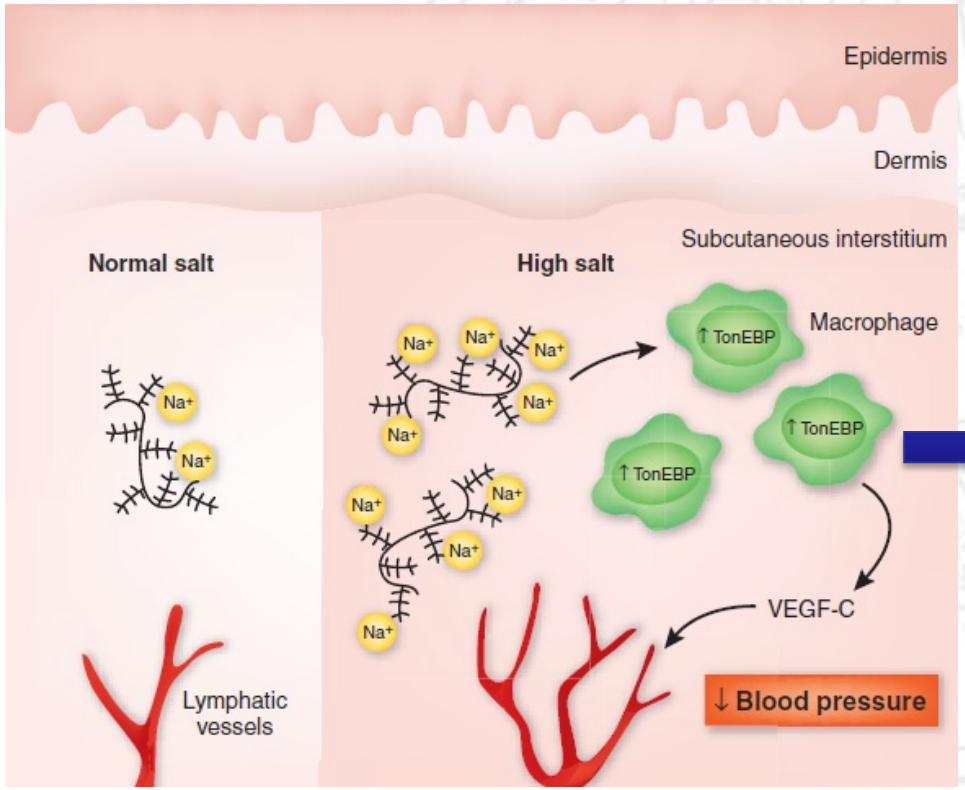
Na^+-bevitel lehetséges szerepe egyéb betegségekben



- Na^+ immunmoduláns hatása

Na^+ és a **macrophagok**

I. Hipertonicitás érzékelése



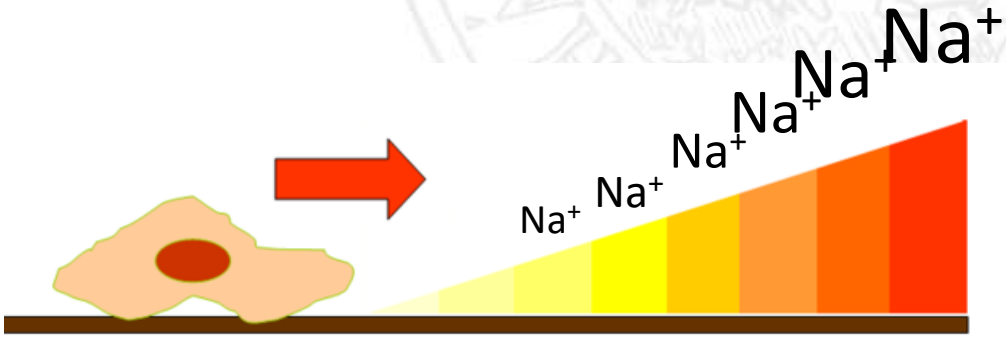
Machnik et al.
Nat Med. 2009 May;15(5):545-52

TonEBP és az immunrendszer kapcsolata:

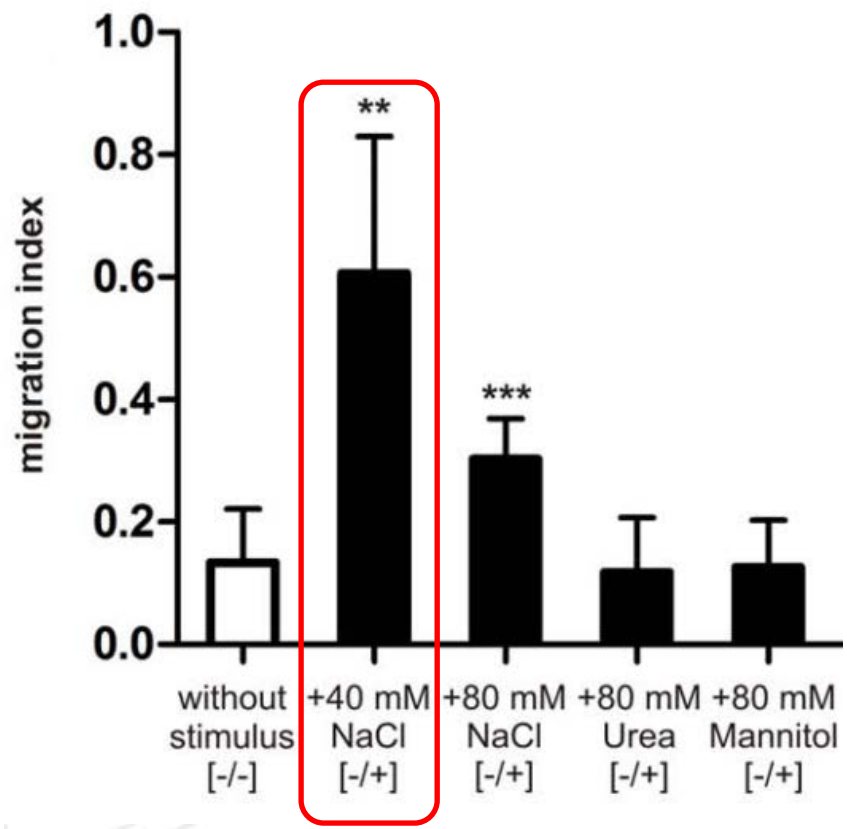
- TNFα
- IL-6
- MCP-1

Na^+ és a **macrophagok**

II. Macrophagok kemotaxisa



Kőhidai László, 2008

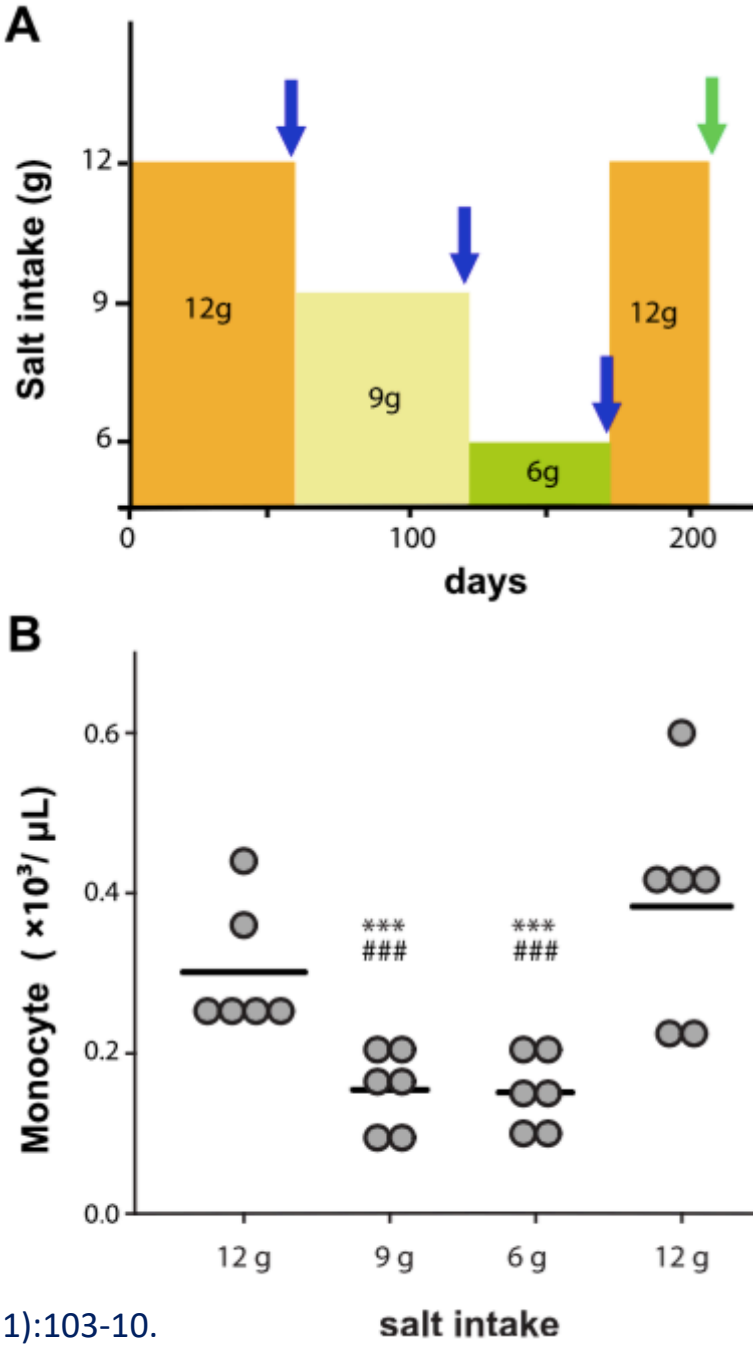


Müller et al.
PLoS One. 2013 Sep 16;8(9):e73439.

Na^+ és a **macrophagok**

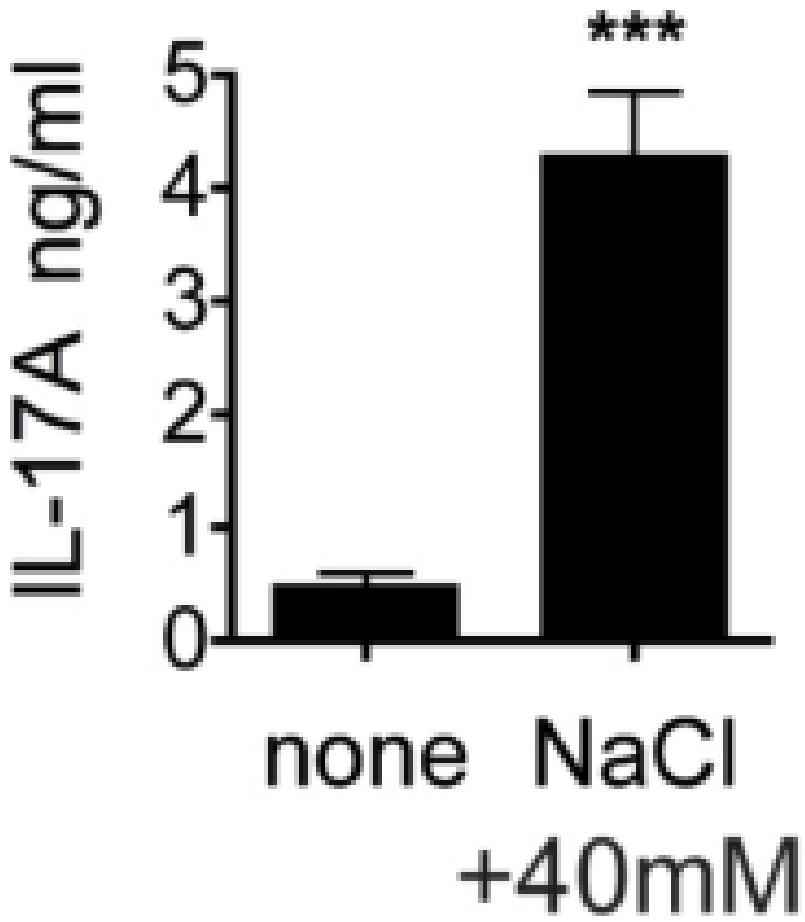
IV. Monocyta-szám ↑

- Pro-inflammatorikus
  - IL-6, IL-23 ↑
- Anti-inflammatorikus
  - IL-10 ↓



Transl Res. 2015 Jul;166(1):103-10.

Na^+ és a **T-sejtek**

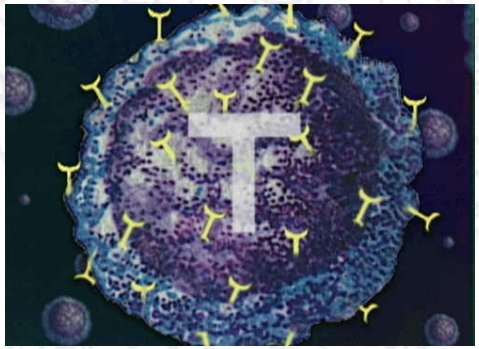


Anti-inflammatorikus **Pro-inflammatorikus**

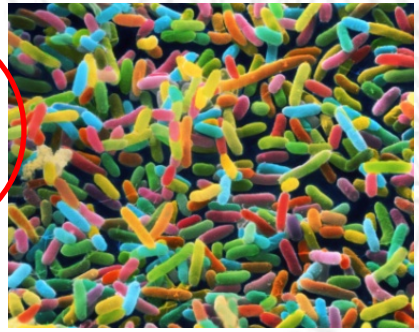
$+Na^{+}$

Na^+ - Microbiome

NaCl



Th17

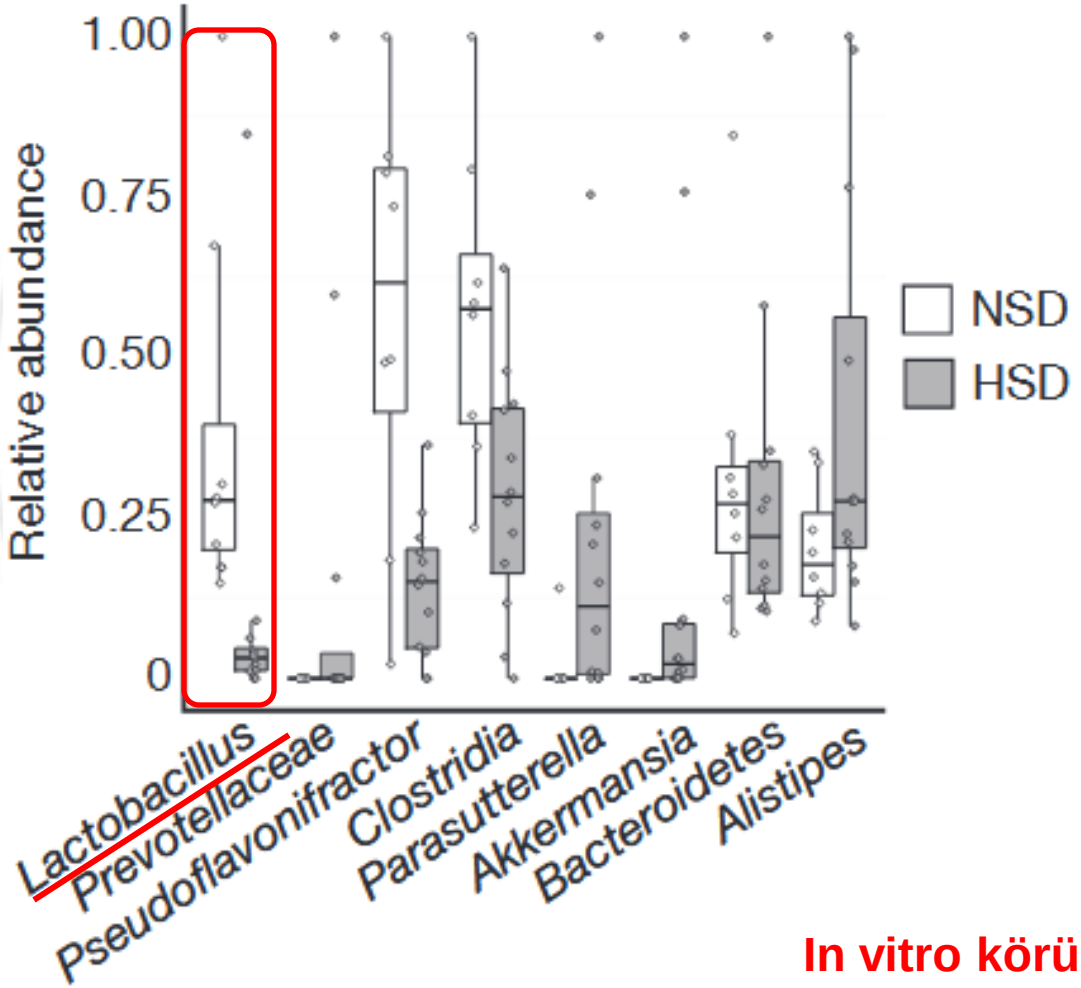


Microbiom

Magas vérnyomás

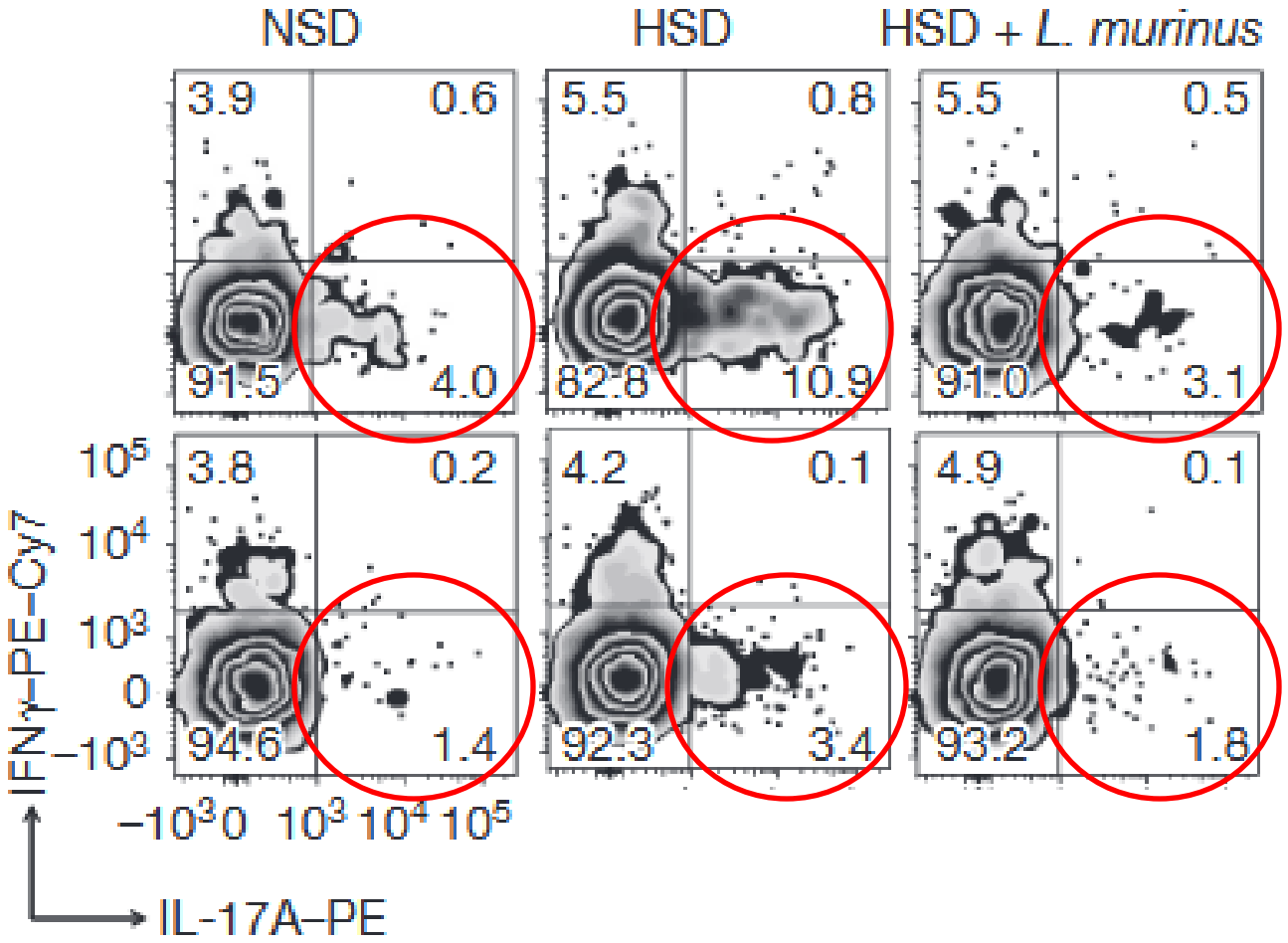
Autoimmun bet.

Sódiéta gátolja a Lactobacillus spp-t in vivo



In vitro körülmények között is!

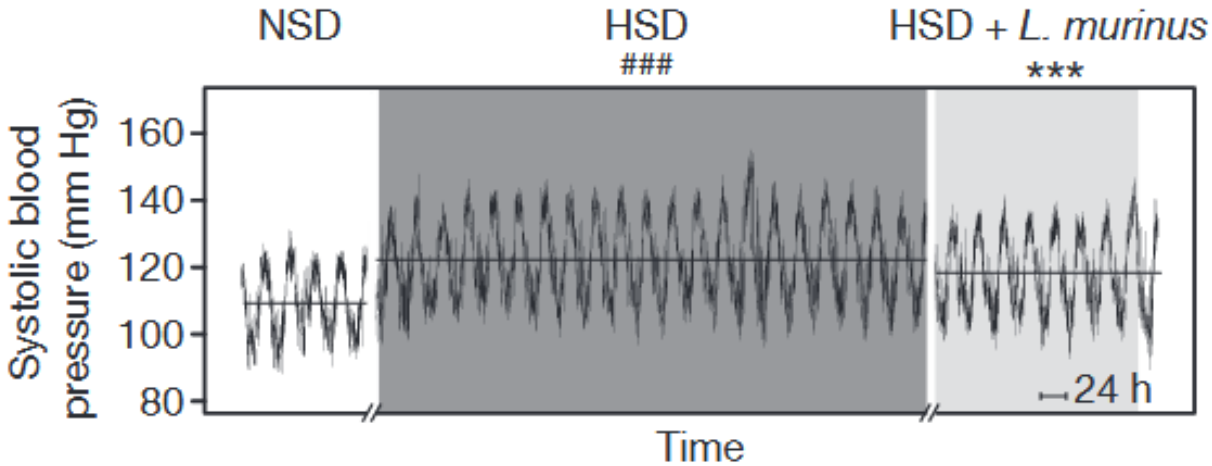
L. Murinus kezelés hatása a Th17 sejtekre

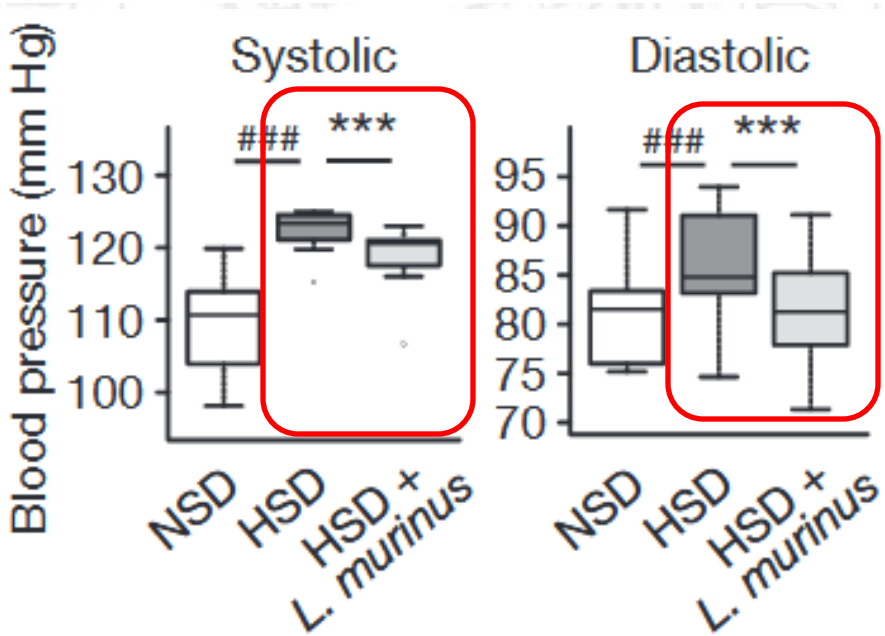


Vékonybél

Vastagbél

L. Murinus csökkenti a sószenzitív hipertóniát





www.impactjournals.com/oncotarget/ Oncotarget, 2017, Vol. 8, (No. 1), pp: 70-82

Research Paper: Immunology

High salt diet stimulates gut Th17 response and exacerbates TNBS-induced colitis in mice

Yingfeng Wei[1], Chong Lu[1], Jianing Chen[1], Guangying Cui[1], Lin Wang[1], Tianming Yu[2], Yue Yang[3], Wei Wu[1], Yulong Ding[1], Lanjuan Li[1], Toshimitsu Uede[4], Zhi Chen[1] and Hongyan Diao[1]

Journal of Crohn's and Colitis Advance Access published July 29, 2016

Manuscript Doi : 10.1093/ecco-jcc/jjw139 *Monteleone I et al 1*

Sodium chloride-enriched diet enhances inflammatory cytokine production and exacerbates experimental colitis in mice

Ivan Monteleone*, Irene Marafini, Vincenzo Dinallo, Davide Di Fusco, Edoardo Troncone, Francesca Zorzi, Federica Laudisi and Giovanni Monteleone

The Journal of Immunology

This information is current as of August 7, 2017.

Dietary Salt Exacerbates Experimental Colitis

Alan L. Tubbs, Bo Liu, Troy D. Rogers, R. Balfour Sartor and Edward A. Miao

J Immunol 2017; 199:1051-1059; Prepublished online 21 June 2017;
doi: 10.4049/jimmunol.1700356

BALANCE YOUR SALT INTAKE WITH 6 STEPS

Limit your daily intake to 1/4 tsp/day

Slowly reduce the use of salt in your diet

Thumb rule: 200mg salt per serving of the product

Remember Processed foods contain high levels of salt

Read product labels & look for salt content

Avoid artificial substitutes of salt