12:30-13:00	DEBATE האם דיאטה דלת מלח אכן הכרחית? (הרצאת חסות פייזר) **מנחה - ד"ר דב גביש** **ד"ר גיא מילוא מחלקת נפרולוגיה ויתר לחץ דם הקריה הרפואית רמב"ם, חיפה - בעד** **ד"ר עידו בן דב מחלקת נפרולוגיה ויתר לחץ דם המרכז הרפואי הדסה, ירושלים - נגד**
13:00	ארוחת צהרים

Sci Rep. 2013;3:1558. doi: 10.1038/srep01558.

Involvement of dietary salt in shaping bacterial communities in European

Sun H[1], Jami E, Harpaz S, Mizrahi I.

Author information

Abstract

Bacteria associated with the digestive tract of multicellular organisms have been shown to play a major role in their hosts' functioning. In fish, it has been proposed that food fermentation occurs inside the pyloric ceca, pouch like organs found in their digestive tract. However, this notion remains controversial. Furthermore, changes in pyloric cecal bacterial populations under different diets have yet to be demonstrated in fish. In this study, we explore the changes occurring in the bacterial community residing in the pyloric ceca of carnivorous fish fed different diets, which were shown to induce different growth rates. Our results revealed that different diets do indeed induce distinct bacterial compositions within the pyloric ceca. We found that, when salt was added to a low fish meal diet, the bacterial changes were accompanied by a significant enhancement in weight gain, hinting at a possible involvement of the bacterial community in energy harvest.

Sodium, blood pressure, and cardiovascular disease

Hillel W. Cohen and Michael H. Alderman

Table 1 Observational cohort studies linking sodium to cardiovascular disease (CVD)

Study	Subjects	Person-years	End points	Association
HHS [16]	7895	78 950	238 strokes	None
MRFIT [20]	11 696	116 960	2714 fatal CHD	None
SHS [17]	11 629	88 380	1178 CVD	None
HPS [15]	43 738	349 904	328 strokes	None
WSH [11]	2937	10 150	55 CHD	Inverse
NHANES I [18]	11 346	215 574	1970 fatal CV	Inverse
NHANES II [23••]	7154	98 010	541 fatal CV	Inverse
NHANES I[a] [19]	2688	43 788	379 fatal CV	Direct
FHS [21]	2463	24 630	148 fatal CV	Direct
Takayama [22]	29 079	203 553	269 strokes	Direct
Totals	130 625	1 229 899	7820	

Adapted from [1]. CHD, coronary heart disease; CV, cardiovascular.
[a] Obese 28%.

Cohen H, Curr Opin Cardiol 2007

Sodium, blood pressure, and cardiovascular disease

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Sodium measure	Hazard ratio	95% confidence interval	*P* value
Sodium per 1000 mg[a,b]	0.89	0.80, 0.99	0.03
Sodium mg per calorie	0.80	0.68, 0.94	0.008
Sodium < 2300 mg	1.37	1.03, 1.81	0.03
Sodium < residuals adjusted median	1.22	1.01, 1.49	0.04

Adapted from [23••]. All models adjusted for age, sex, race, smoking, alcohol use, systolic blood pressure, antihypertensive treatment, BMI, education less than high school, physical activity, dietary potassium, history of diabetes, serum cholesterol. Models for sodium (continuous) and sodium less than 2300 mg also adjusted for calories.

[a] To convert values to mmol divide by 23.

Cohen H, Curr Opin Cardiol 2007

Table 2 Adjusted Mortality Hazard Ratios for Dietary Sodium Measures*

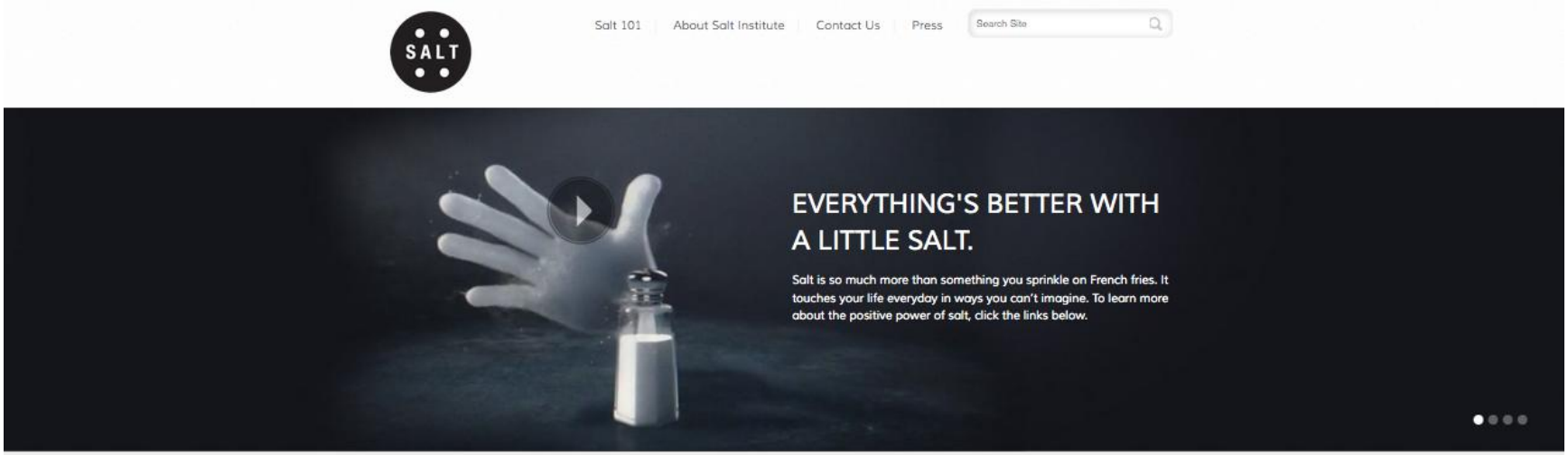
Mortality Outcome	Sodium Measure	Hazard Ratio	95 % Confidence Interval	*P* Value
Cardiovascular disease	Sodium per 1000 mg†‡	0.89	0.80, 0.99	.03
	Sodium mg per calorie	0.80	0.68, 0.94	.008
	Sodium <2300 mg	1.37	1.03, 1.81	.03
	Sodium <residuals adjusted median	1.22	1.01, 1.49	.04
All-cause	Sodium per 1000 mg	0.93	0.87, 1.00	.06
	Sodium mg per calorie	0.89	0.79, 1.00	.05
	Sodium <2300 mg	1.28	1.10, 1.50	.003
	Sodium <residuals adjusted median	1.12	0.97, 1.30	.13
Coronary heart disease	Sodium per 1000 mg	0.91	0.79, 1.05	.21
	Sodium mg per calorie	0.79	0.63, 0.99	.04
	Sodium <2300 mg	1.21	0.87, 1.68	.25
	Sodium <residuals adjusted median	1.19	0.93, 1.52	.16
Cerebrovascular disease	Sodium per 1000 mg	0.95	0.75, 1.21	.68
	Sodium mg per calorie	0.91	0.60, 1.37	.63
	Sodium <2300 mg	1.78	0.89, 3.55	.10
	Sodium <residuals adjusted median	1.05	0.58, 1.88	.87

*All models adjusted for age, sex, race, smoking, alcohol use, systolic blood pressure, anti-hypertensive treatment, body mass index, education <high school, physical activity, body mass index, dietary potassium, history of diabetes, serum cholesterol. Models for sodium (continuous) and sodium <2300 mg also adjusted for calories.

†To convert values to mmol divide by 23.

‡Results for residuals adjusted sodium as a continuous variable were exactly the same as without that additional adjustment.

הוכחות מסוג זה לא יספיקו...



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EUROPEAN POPULATION STUDY

Fatal and Nonfatal Outcomes, Incidence of Hypertension, and Blood Pressure Changes in Relation to Urinary Sodium Excretion

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Jan A. Staessen, MD, PhD
for the European Project on Genes in Hypertension (EPOGH) Investigators

Context Extrapolations from observational studies and short-term intervention trials suggest that population-wide moderation of salt intake might reduce cardiovascular events.

Objective To assess whether 24-hour urinary sodium excretion predicts blood pressure (BP) and health outcomes.

Design, Setting, and Participants Prospective population study, involving 3681 participants without cardiovascular disease (CVD) who are members of families that were randomly enrolled in the Flemish Study on Genes, Environment, and Health Outcomes (1985-2004) or in the European Project on Genes in Hypertension (1999-2001). Of 3681 participants without CVD, 2096 were normotensive at baseline and 1499 had BP and sodium excretion measured at baseline and last follow-up (2005-2008).

Main Outcome Measures Incidence of mortality and morbidity and association between changes in BP and sodium excretion. Multivariable-adjusted hazard ratios (HRs) express the risk in tertiles of sodium excretion relative to average risk in the whole study population.

Results Among 3681 participants followed up for a median 7.9 years, CVD deaths decreased across increasing tertiles of 24-hour sodium excretion, from 50 deaths in the low (mean, 107 mmol), 24 in the medium (mean, 168 mmol), and 10 in the high excretion group (mean, 260 mmol; $P<.001$), resulting in respective death rates of 4.1% (95% confidence interval [CI], 3.5%-4.7%), 1.9% (95% CI, 1.5%-2.3%), and 0.8% (95% CI, 0.5%-1.1%). In multivariable-adjusted analyses, this inverse association retained significance ($P=.02$): the HR in the low tertile was 1.56 (95% CI, 1.02-2.36; $P=.04$). Baseline sodium excretion predicted neither total mortality ($P=.10$) nor fatal combined with nonfatal CVD events ($P=.55$). Among 2096 participants followed up for 6.5 years, the risk of hypertension did not increase across increasing tertiles ($P=.93$). Incident hypertension was 187 (27.0%; HR, 1.00; 95% CI, 0.87-1.16) in the low, 190 (26.6%; HR, 1.02; 95% CI, 0.89-1.16) in the medium, and 175 (25.4%; HR , 0.98; 95% CI, 0.86-1.12) in the high sodium excretion group. In 1499 participants followed up for 6.1 years, systolic blood pressure increased by 0.37 mm Hg per year ($P<.001$), whereas sodium excretion did not change (–0.45 mmol per year, $P=.15$). However, in multivariable-adjusted analyses, a 100-mmol increase in sodium excretion was associated with 1.71 mm Hg increase in systolic blood pressure ($P.<001$) but no change in diastolic BP.

Conclusions In this population-based cohort, systolic blood pressure, but not diastolic pressure, changes over time aligned with change in sodium excretion, but this association did not translate into a higher risk of hypertension or CVD complications. Lower sodium excretion was associated with higher CVD mortality.

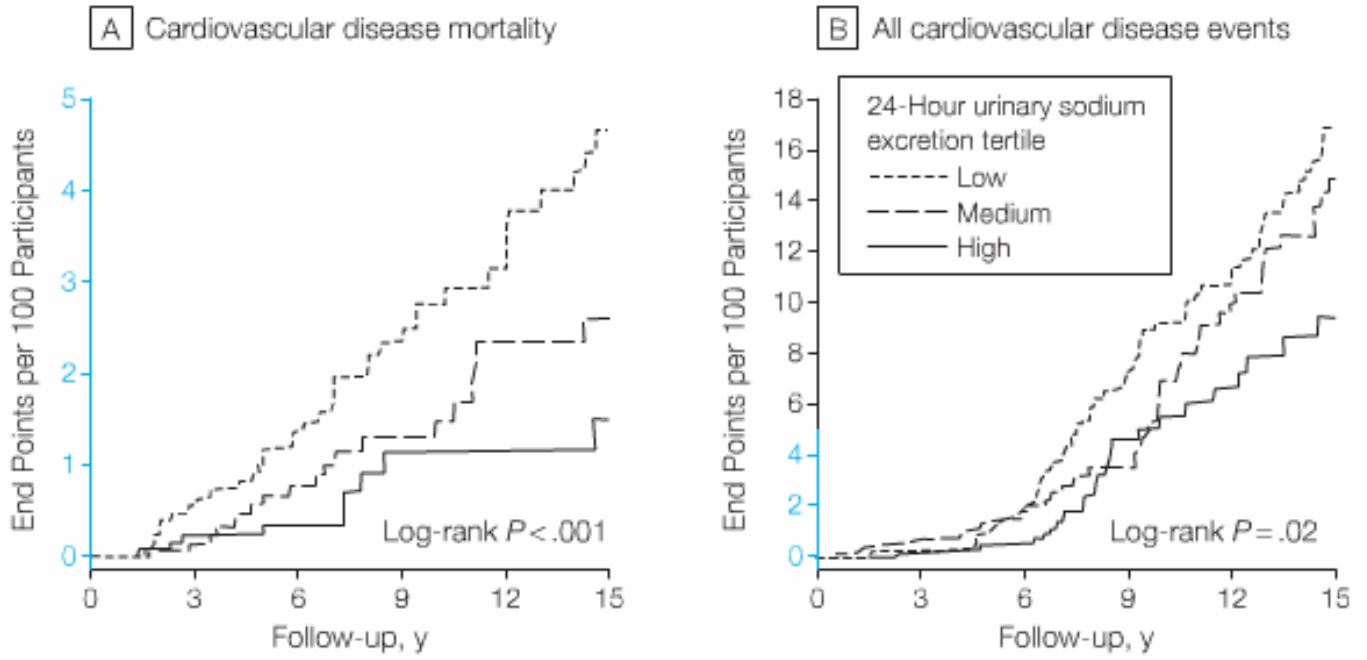
JAMA. 2011;305(17):1777-1785 www.jama.com

THE EVIDENCE RELATING BLOOD pressure to salt intake in humans originates from population-based studies[1] and randomized clinical trials of interventions on dietary salt intake.[2,3] Across 52 INTERSALT centers, the median 24-hour urinary sodium excretion ranged from 0.2 to 242.1 mmol.[1] After standardization for sex and age and with adjustments for body mass index and alcohol intake, the cross-sectionally assessed age-related increase in sys-

Table 1. Baseline Characteristics of Study Participants by Cohort[a]

Characteristics	Cohort		
	Outcome (n = 3681)	Hypertension (n = 2096)	Blood Pressure (n = 1499)
Follow-up, median (IQR), y	7.93 (6.35-17.20)	6.48 (5.13-9.19)	6.14 (5.14-7.93)
Participant characteristics, No. (%)			
FLEMENGHO	2674 (72.6)	1644 (78.4)	1109 (74.0)
EPOGH	1007 (27.4)	452 (21.6)	390 (26.0)
Women	1941 (52.7)	1133 (54.1)	786 (52.4)
Hypertension	949 (25.8)		148 (9.9)
Diabetes mellitus	152 (4.1)	40 (1.9)	29 (1.9)
Antihypertensive treatment	443 (12.0)		
Use of female sex hormones	381 (10.4)	250 (11.9)	165 (11.0)
Use of NSAIDs	502 (13.6)	283 (13.5)	185 (12.3)
Educational attainment, No. (%)			
≤Elementary school	1210 (32.9)	679 (32.4)	437 (29.1)
Secondary school	1896 (51.5)	1118 (53.3)	854 (57.0)
Higher education	575 (15.6)	299 (14.3)	208 (13.9)
Smokers, No. (%)	1044 (28.4)	653 (31.2)	455 (30.4)
Alcohol intake ≥5 g/d, No. (%)	886 (24.1)	465 (22.2)	345 (23.0)
Characteristic, mean (SD)			
Age, y	40.9 (16.3)	38.6 (14.6)	38.3 (14.2)
Blood pressure, mm Hg[b]			
Systolic	124.7 (17.1)	118.7 (10.4)	120.9 (12.8)
Diastolic	76.3 (10.6)	73.3 (8.0)	74.6 (8.9)
BMI	25.2 (4.6)	24.5 (4.0)	24.6 (4.0)
Total cholesterol, mg/dL	209 (46)	207 (46)	207 (42)
24-h urinary measurements, mean (SD)			
Duration, h:m	23:52 (00:59)	23:51 (01:02)	23:48 (01:08)
Volume, L	1.52 (0.64)	1.52 (0.65)	1.54 (0.65)
Sodium, mmol	178.0 (74.8)	174.2 (74.1)	172.7 (62.5)
Potassium, mmol	66.2 (26.3)	66.8 (25.5)	66.3 (22.4)
Sodium-to-potassium ratio	2.93 (1.56)	2.81 (1.27)	2.78 (1.12)
Creatinine, mmol	11.6 (3.9)	11.7 (3.8)	11.9 (3.7)

Figure 2. Kaplan-Meier Survival Function Estimates for Cardiovascular Mortality and All Cardiovascular Events



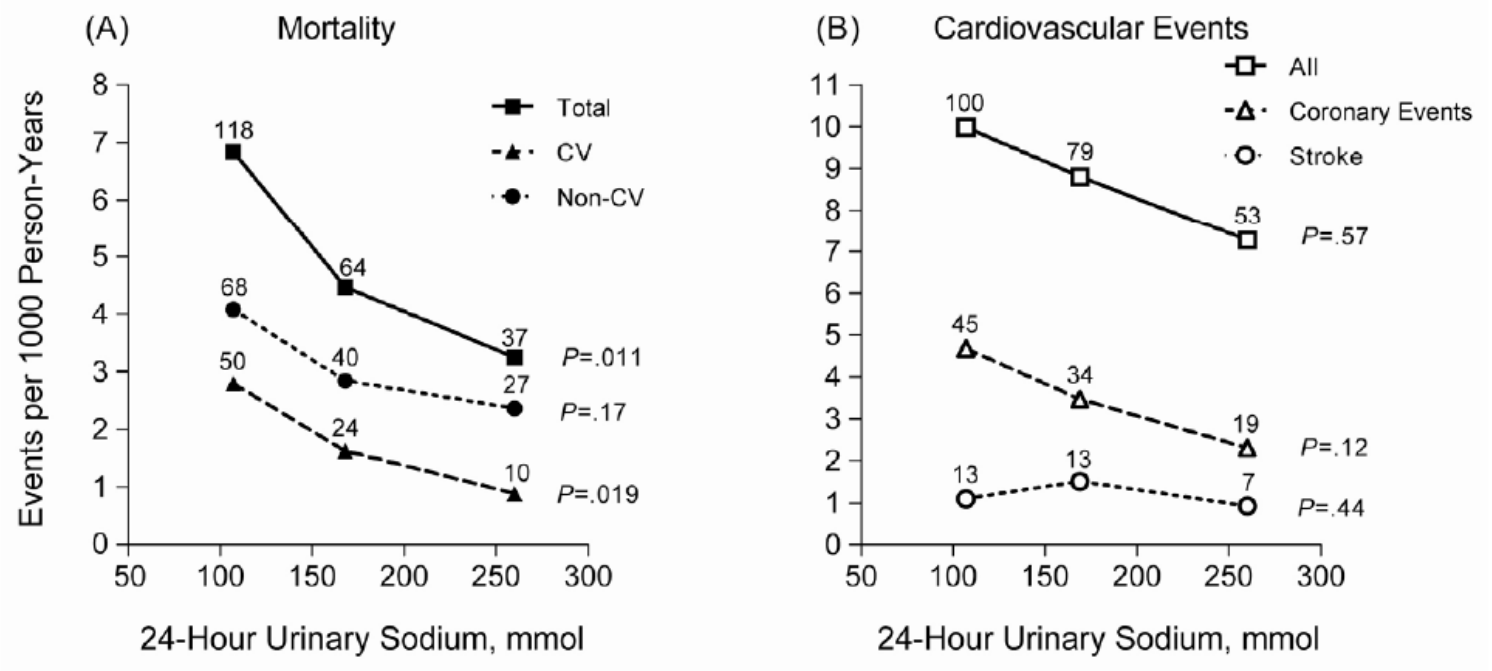
No. at risk by Tertile

Low	1220	1190	997	709	457	429
Medium	1250	1225	968	609	416	389
High	1211	1189	906	430	291	272

1220	1190	997	709	457	429
1250	1225	968	609	416	389
1211	1189	906	430	291	272

Tertiles of 24-hour urinary sodium excretion are sex-specific based on baseline measures (see Table 2). This analysis includes the outcome cohort (see Figure 1 and Table 1). Regions of y-axis scales drawn in blue indicate range from 0 to 5.

eFigure 1. Incidence of Mortality and All Cardiovasular Events



Incidence of mortality (A) and cardiovascular events (B) by tertiles of the distributions of the 24-hour urinary sodium excretion at baseline. This analysis includes the *Outcome Cohort* (n=3681; see Figure 1 and Table 1). Incidence rates were standardized for study population, sex, and age by the direct method. The number of events contributing to the rates is presented. CV and Non-CV indicate cardiovascular and noncardiovascular mortality, respectively. The data markers are centered to the means of the 24-hour urinary sodium excretion in each tertile of the distribution. For the mean and range of the 24-hour sodium excretion in each tertile, see Table 2. The *P*-values are for linear trend across the tertiles of the 24-hour sodium excretion and were computed using Cox proportional regression models with study population, sex and age at baseline as covariables.

Table 2. Mortality and Cardiovascular Events by Tertiles of the 24-Hour Urinary Sodium Excretion at Baseline

		24-Hour Urinary Sodium Excretion Tertiles at Baseline						
		Low (n = 1220)		Medium (n = 1250)		High (n = 1211)		
No. of women		645		658		638		
Range, mmol		50-126		127-177		178-400		
Mean (SD), mmol		95.1 (22.0)		150.2 (15.0)		231.7 (50.9)		
No. of men		575		592		573		
Range, mmol		50-158		159-221		222-400		
Mean (SD), mmol		120.1 (28.4)		188.8 (17.6)		290.5 (56.2)		
	Total No. of Events of Outcome Cohort	No. of Events	Adjusted HR (95% CI)[a]	No. of Events	Adjusted HR (95% CI)[a]	No. of Events	Adjusted HR (95% CI)[a]	*P* Value
Mortality								
All causes	**219**	118	1.14 (0.87-1.50)	64	0.94 (0.75-1.18)	37	1.06 (0.84-1.33)	.10
Cardiovascular	**84**	50	1.56 (1.02-2.36)[b]	24	1.05 (0.72-1.53)	10	0.95 (0.66-1.38)	.02
Noncardiovascular	**135**	68	0.98 (0.71-1.36)	40	0.90 (0.68-1.20)	27	1.11 (0.83-1.47)	.64
Fatal and nonfatal events								
All cardiovascular	**232**	100	1.13 (0.90-1.42)	79	1.11 (0.90-1.36)	53	0.90 (0.73-1.11)	.55
Coronary	**98**	45	1.42 (0.99-2.04)	34	1.17 (0.89-1.54)	19	0.86 (0.65-1.13)	.10
Stroke	**33**	13	1.07 (0.57-2.00)	13	1.29 (0.75-2.20)	7	0.78 (0.45-1.33)	.64

Abbreviations: CI, confidence interval; HR, hazard ratio.

This analysis includes the outcome cohort (see Figure 1 and Table 1).

[a] Hazard ratios were computed by deviation from mean coding[25] and express the risk in each tertile of the distribution of 24-hour urinary sodium excretion at baseline compared with the overall risk in the whole outcome cohort. We applied Cox proportional hazard regression to derive HRs, while allowing for covariables and accounting for family clusters. All HRs were adjusted for study population, sex, and baseline variables: age, body mass index, systolic blood pressure, 24-hour urinary potassium excretion, antihypertensive drug treatment, smoking and drinking alcohol, diabetes, total cholesterol, and educational attainment. Adjustment for diastolic blood pressure or mean arterial pressure did not materially alter the findings. *P* values are for linear trend across the tertiles of 24-hour sodium excretion.

[b] $P = .04$.

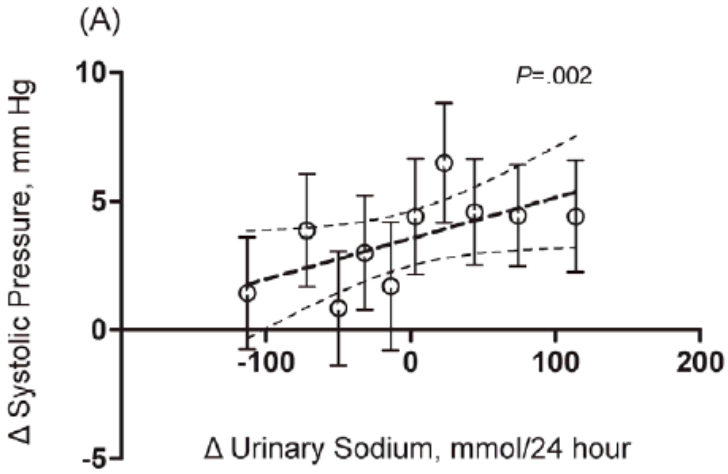
Table 3. Multivariable Adjusted Longitudinal Associations Between Changes in Blood Pressure and 24-Hour Urinary Sodium by Study Population[a]

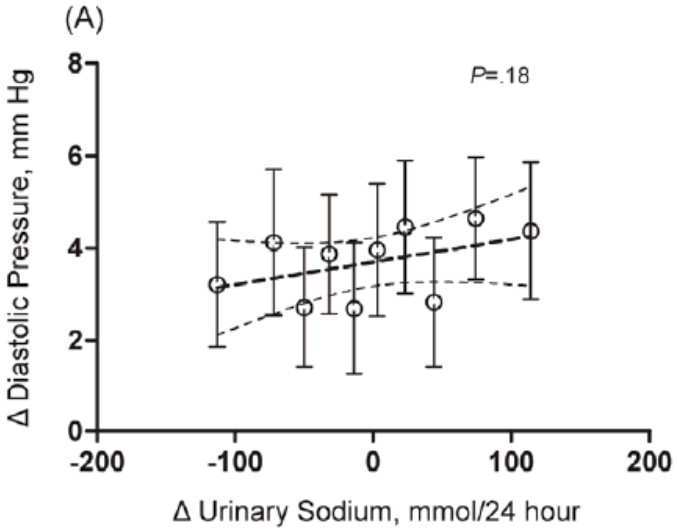
Study Population	Absolute		Relative	
	Estimates (95% CI)[b]	*P* Value	Estimates (95% CI)[b]	*P* Value
Change in systolic pressure				
FLEMENGHO	2.373 (1.154 to 3.392)	<.001	2.740 (1.410 to 4.069)	<.001
EPOGH	0.196 (–1.409 to 1.801)	.81	0.085 (–2.181 to 2.351)	.94
All	1.711 (0.786 to 2.637)	<.001	2.211 (1.059 to 3.364)	<.001
Change in diastolic pressure				
FLEMENGHO	0.576 (–0.246 to 1.398)	.17	1.476 (–0.113 to 3.065)	.07
EPOGH	–0.052 (–1.317 to 1.212)	.94	–0.175 (–3.064 to 2.714)	.90
All	0.379 (–0.313 to 1.070)	.28	1.107 (–0.279 to 2.492)	.12

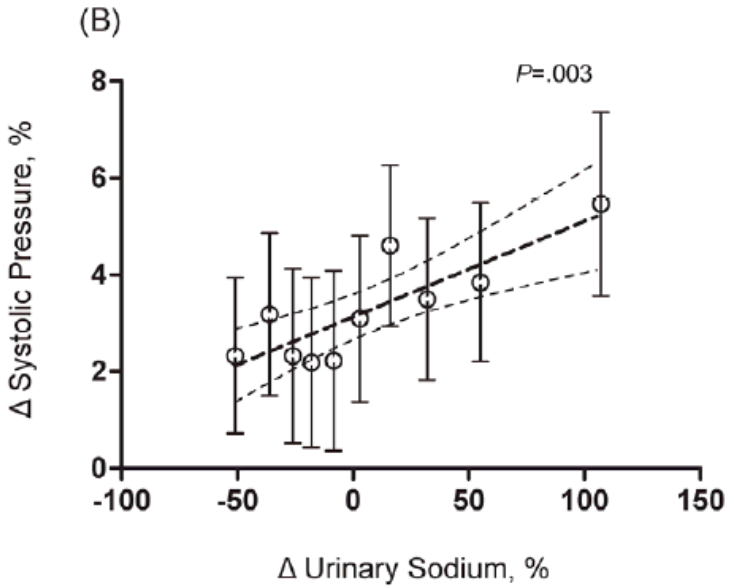
Abbreviations: CI, confidence interval; EPOGH, the European Project on Genes in Hypertension; FLEMENGHO, Flemish Study on Environment, Genes, and Health Outcomes.

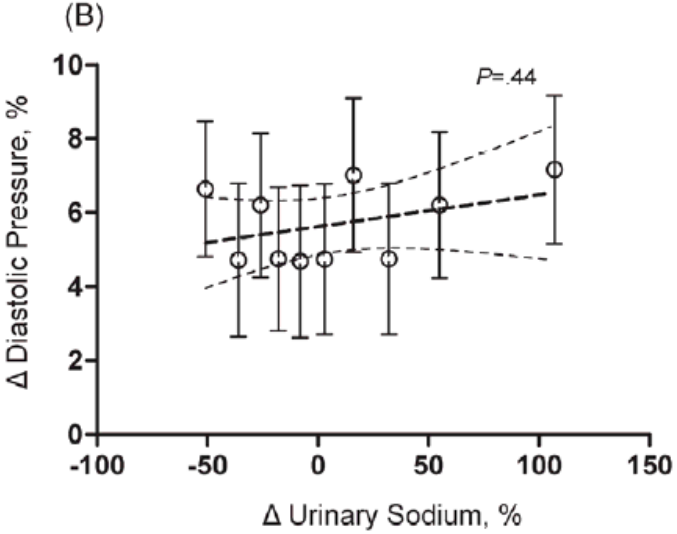
[a] Reasons for exclusion from analysis are explained in the "Methods" section.

[b] Estimates and 95% CIs express the change in systolic blood pressure per 100-millimole increase in 24-hour urinary sodium excretion or the percentage change in systolic pressure for a doubling of 24-hour urine sodium. Parameter adjustment definitions are in the "Results" section. Estimates for all participants were adjusted for study population.


(A)
P=.002
Δ Systolic Pressure, mm Hg
10
5
0
-5
-100
0
100
200
Δ Urinary Sodium, mmol/24 hour


(A)
P=.18
Δ Diastolic Pressure, mm Hg
8
6
4
2
0
-200
-100
0
100
200
Δ Urinary Sodium, mmol/24 hour

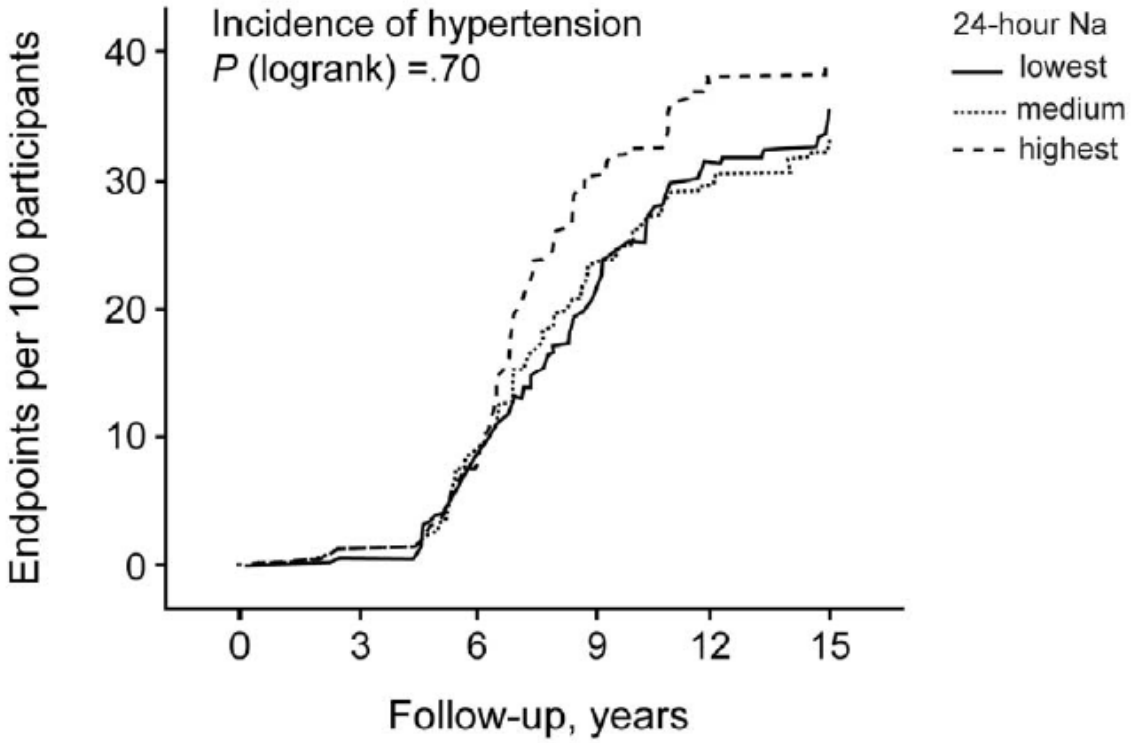

(B)
P=.003
Δ Systolic Pressure, %
8
6
4
2
0
-100
-50
0
50
100
150
Δ Urinary Sodium, %


(B)
P=.44
Δ Diastolic Pressure, %
10
8
6
4
2
0
-100
-50
0
50
100
150
Δ Urinary Sodium, %

eTable 12. Multivariable-Adjusted Hazard Ratios for Incidence of Hypertension by Tertiles of the 24-Hour Urinary Sodium Excretion at Baseline.

	24-Hour Urinary Sodium Excretion Tertiles						
	Low (n=693)		Medium (n=713)		High (n=690)		
No. of women	375		385		373		
Range, mmol	50–124		125–173		174–400		
Mean (SD), mmol	94.7 (21.5)		147.4 (14.3)		222.1 (47.2)		
No. of men	318		328		317		
Range, mmol	50–157		158–214		215–400		
Mean (SD), mmol	121.3 (27.9)		185.3 (16.1)		282.2 (56.4)		
	No. of Events	Adjusted HR (95% CI)[a]	No. of Events	Adjusted HR (95% CI)[a]	No. of Events	Adjusted HR (95% CI)[a]	*P* Value
Study population							
FLEMENGHO (434)	163	1.00 (0.84 to 1.19)	155	1.00 (0.86 to 1.16)	116	1.00 (0.86 to 1.16)	.97
EPOGH (118)	24	0.98 (0.76 to 1.27)	35	1.20 (0.89 to 1.62)	59	0.83 (0.62 to 1.12)	.55
All (552)	187	1.00 (0.87 to 1.16)	190	1.02 (0.89 to 1.16)	175	0.98 (0.86 to 1.12)	.93

eFigure 2. Kaplan-Meier Estimates for the Incidence of Hypertension by Tertiles of the 24-Hour Urinary Sodium Excretion at Baseline



ONTARGET AND TRANSCEND PARTICIPANTS

Urinary Sodium and Potassium Excretion and Risk of Cardiovascular Events

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Context The precise relationship between sodium and potassium intake and cardiovascular (CV) risk remains uncertain, especially in patients with CV disease.

Objective To determine the association between estimated urinary sodium and potassium excretion (surrogates for intake) and CV events in patients with established CV disease or diabetes mellitus.

Design, Setting, and Patients Observational analyses of 2 cohorts (N=28 880) included in the ONTARGET and TRANSCEND trials (November 2001-March 2008 from initial recruitment to final follow-up). We estimated 24-hour urinary sodium and potassium excretion from a morning fasting urine sample (Kawasaki formula). We used restricted cubic spline plots to describe the association between sodium and potassium excretion and CV events and mortality, and to identify reference categories for sodium and potassium excretion. We used Cox proportional hazards multivariable models to determine the association of urinary sodium and potassium with CV events and mortality.

Main Outcome Measures CV death, myocardial infarction (MI), stroke, and hospitalization for congestive heart failure (CHF).

Results At baseline, the mean (SD) estimated 24-hour excretion for sodium was 4.77 g (1.61); and for potassium was 2.19 g (0.57). After a median follow-up of 56 months, the composite outcome occurred in 4729 (16.4%) participants, including 2057 CV deaths, 1412 with MI, 1282 with stroke, and 1213 with hospitalization for CHF. Compared with the reference group with estimated baseline sodium excretion of 4 to 5.99 g per day (n=14 156; 6.3% participants with CV death, 4.6% with MI, 4.2% with stroke, and 3.8% admitted to hospital with CHF), higher baseline sodium excretion was associated with an increased risk of CV death (9.7% for 7-8 g/day; hazard ratio [HR], 1.53; 95% CI, 1.26-1.86; and 11.2% for >8 g/day; HR, 1.66; 95% CI, 1.31-2.10), MI (6.8%; HR, 1.48; 95% CI, 1.11-1.98 for >8 g/day), stroke (6.6%; HR, 1.48; 95% CI, 1.09-2.01 for >8 g/day), and hospitalization for CHF (6.5%; HR, 1.51; 1.12-2.05 for >8 g/day). Lower sodium excretion was associated with an increased risk of CV death (8.6%; HR, 1.19; 95% CI, 1.02-1.39 for 2-2.99 g/day; 10.6%; HR, 1.37; 95% CI, 1.09-1.73 for <2 g/day), and hospitalization for CHF (5.2%; HR, 1.23; 95% CI, 1.01-1.49 for 2-2.99 g/day) on multivariable analysis. Compared with an estimated potassium excretion of less than 1.5 g per day (n=2194; 6.2% with stroke), higher potassium excretion was associated with a reduced risk of stroke (4.7% [HR, 0.77; 95% CI, 0.63-0.94] for 1.5-1.99 g/day; 4.3% [HR, 0.73; 95% CI, 0.59-0.90] for 2-2.49 g/day; 3.9% [HR, 0.71; 95% CI, 0.56-0.91] for 2.5-3 g/day; and 3.5% [HR, 0.68; 95% CI, 0.49-0.92] for >3 g/day) on multivariable analysis.

Conclusions The association between estimated sodium excretion and CV events was J-shaped. Compared with baseline sodium excretion of 4 to 5.99 g per day, sodium excretion of greater than 7 g per day was associated with an increased risk of all CV events, and a sodium excretion of less than 3 g per day was associated with increased risk of CV mortality and hospitalization for CHF. Higher estimated potassium excretion was associated with a reduced risk of stroke.

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THERE IS UNCERTAINTY REGARDING the optimal daily intake of sodium, which confers most protection against the risk of cardiovascular (CV) disease.[1] The World Health Organization[2] recommends a sodium intake of less than 2 g per day, a level that is largely based on projections made from relatively small and short-term clinical trials evaluating the effects of sodium restriction on blood pressure in primary prevention populations.[3] However, findings from prospective cohort studies, evaluating the association between sodium intake and CV events, have been conflicting.[1] For example, although some have reported a positive association between sodium intake and CV mortality,[4-7] others have not,[8-11] and some have reported an inverse association.[12,13] In particular, a re-

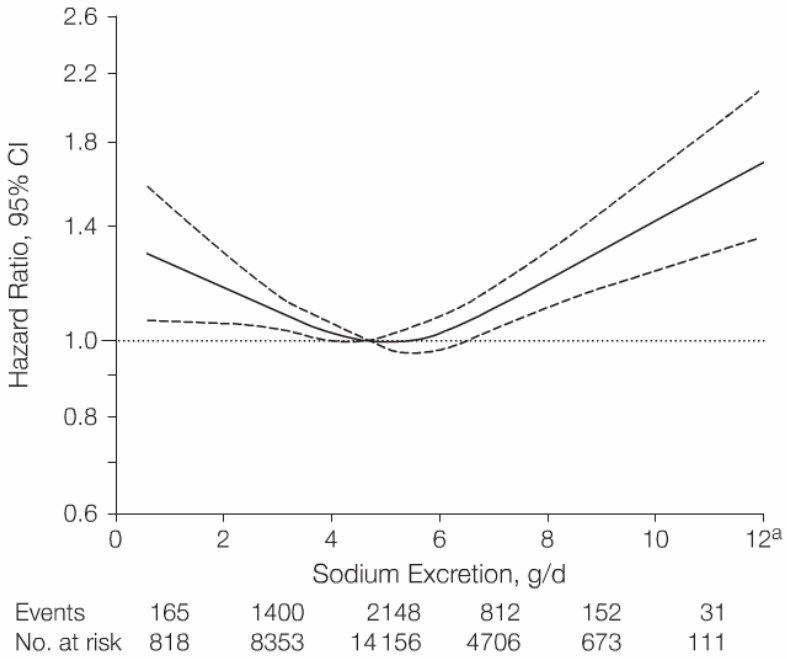
For editorial comment see p 2262.

Author Audio Interview available at www.jama.com.

Table 1. Baseline Patient Characteristics by 24-Hour Sodium Excretion Range[a]

Variable	Overall (N = 28 880)	Sodium Excretion, g/d[b] <2 (n = 818)	2-3.99 (n = 8353)	4-5.99 (n = 14 156)	6-8 (n = 4706)	>8 (n = 847)	*P* Value
Sodium excretion, mean (SD), g/d	4.77 (1.61)	1.55 (0.35)	3.24 (0.53)	4.93 (0.56)	6.71 (0.53)	9.40 (1.81)	<.001
Potassium excretion, mean (SD), g/d	2.19 (0.57)	1.81 (0.43)	2.03 (0.48)	2.19 (0.51)	2.40 (0.55)	2.93 (1.16)	<.001
Age, mean (SD), y	66.52 (7.22)	67.61 (7.62)	67.04 (7.42)	66.46 (7.15)	65.79 (6.95)	65.37 (6.75)	<.001
Women	8504 (29.4)	438 (53.5)	3172 (38.0)	3764 (26.6)	952 (20.2)	178 (21.0)	<.001
White/European[c]	20 628 (71.4)	521 (63.7)	5851 (70.0)	10 249 (72.4)	3387 (72.0)	620 (73.2)	<.001
Previous medical history							
Myocardial infarction	13 967 (48.4)	381 (46.6)	4024 (48.2)	6942 (49.0)	2235 (47.5)	385 (45.5)	.08
Stroke/TIA	6118 (21.2)	190 (23.2)	1916 (22.9)	2860 (20.2)	960 (20.4)	192 (22.7)	<.001
Hypertension	20 200 (69.9)	640 (78.2)	5761 (69.0)	9616 (67.9)	3488 (74.1)	695 (82.1)	<.001
Diabetes mellitus	10 717 (37.1)	320 (39.1)	2691 (32.2)	5128 (36.2)	2141 (45.5)	437 (51.6)	<.001
Lifestyle risk factors							
Vegetables, mean (SD), servings/d	1.94 (1.83)	1.90 (2.14)	1.89 (1.90)	1.96 (1.79)	1.96 (1.77)	1.88 (1.52)	.03
Fruit, mean (SD), servings/d	1.79 (1.83)	1.94 (1.74)	1.85 (1.92)	1.78 (1.82)	1.70 (1.72)	1.69 (1.78)	<.001
Current smoker	3502 (12.1)	89 (10.9)	1134 (13.6)	1672 (11.8)	524 (11.1)	83 (9.8)	<.001
Mainly sedentary lifestyle	6486 (22.5)	248 (30.3)	1950 (23.3)	3030 (21.4)	1055 (22.4)	203 (24.0)	<.001
BMI, mean (SD)[d]	28.10 (4.55)	27.32 (4.63)	27.48 (4.51)	28.05 (4.38)	29.13 (4.70)	30.17 (5.09)	<.001
Atrial fibrillation							
Baseline	959 (3.3)	42 (5.1)	297 (3.6)	413 (2.9)	175 (3.7)	32 (3.8)	<.001
Follow-up	2643 (9.2)	97 (11.9)	766 (9.2)	1242 (8.8)	447 (9.5)	91 (10.7)	.01
SBP, mean (SD), mm Hg							
Baseline	141.72 (17.29)	138.61 (17.63)	140.81 (17.32)	141.96 (17.39)	142.95 (16.80)	142.93 (17.01)	<.001
Change at follow-up	−5.54 (21.77)	−1.84 (22.61)	−5.22 (22.04)	−5.91 (21.73)	−5.81 (21.10)	−4.64 (22.33)	<.001
Heart rate, beats/min, mean (SD)							
Baseline	67.98 (12.16)	69.68 (12.22)	68.12 (12.32)	67.49 (12.15)	68.61 (11.85)	69.54 (11.88)	<.001
Follow-up	69.11 (8.88)	69.80 (8.97)	69.02 (8.89)	68.83 (8.89)	69.80 (8.85)	70.26 (8.49)	<.001
Laboratory values, mean (SD)							
HDL, mmol/L	1.26 (0.41)	1.28 (0.41)	1.28 (0.41)	1.26 (0.41)	1.25 (0.41)	1.23 (0.36)	<.001
LDL, mmol/L	2.94 (0.98)	2.94 (1.06)	2.94 (1.00)	2.93 (0.97)	2.95 (0.98)	2.99 (0.98)	.24
Creatinine, μmol/L	93.92 (24.41)	95.55 (27.47)	94.15 (25.18)	93.82 (23.80)	93.54 (24.05)	93.75 (25.72)	.22
Medications							
β-Blocker	16 529 (57.2)	476 (58.2)	4857 (58.1)	8074 (57.0)	2647 (56.2)	475 (56.1)	.22
Diuretic	8299 (28.7)	335 (41.0)	2568 (30.7)	3663 (25.9)	1366 (29.0)	367 (43.3)	<.001
Calcium antagonist	9986 (34.6)	363 (44.4)	2700 (32.3)	4572 (32.3)	1921 (40.8)	430 (50.8)	<.001
Ramipril	7851 (27.2)	210 (25.7)	2278 (27.3)	3859 (27.3)	1291 (27.4)	213 (25.1)	.57
Telmisartan	10 518 (36.4)	296 (36.2)	3082 (36.9)	5090 (36.0)	1750 (37.2)	300 (35.4)	.45
Ramipril plus telmisartan	7792 (27.0)	206 (25.2)	2215 (26.5)	3889 (27.5)	1247 (26.5)	235 (27.7)	.31

Figure 1. Estimated 24-Hour Urinary Excretion of Sodium and Composite of Cardiovascular Death, Stroke, Myocardial Infarction, and Hospitalization for Congestive Heart Failure



Spline plot for adjusted Cox models. Median intake is reference standard. Salt approximates 2.5 × sodium g per day. Model was adjusted for age, sex, race/ethnicity (white vs nonwhite); prior history of stroke or myocardial infarction; creatinine, body mass index; comorbid vascular risk factors (hypertension, diabetes mellitus, atrial fibrillation, smoking, low- and high-density lipoprotein); treatment allocation (ramipril, telmisartan, neither, or both); treatment with statins, β-blockers, diuretic therapy, calcium antagonist, and antithrombotic therapy; fruit and vegetable consumption, level of exercise; baseline blood pressure and change in systolic blood pressure from baseline to last follow-up; and urinary potassium. Dashed lines indicate 95% CIs. Events and numbers at risk are shown between values on x-axis because they indicate the numeric range between these values.

[a] Spline curve truncated at 12 g per day (63 participants had sodium excretion >12 g/d, event rate 21/63).

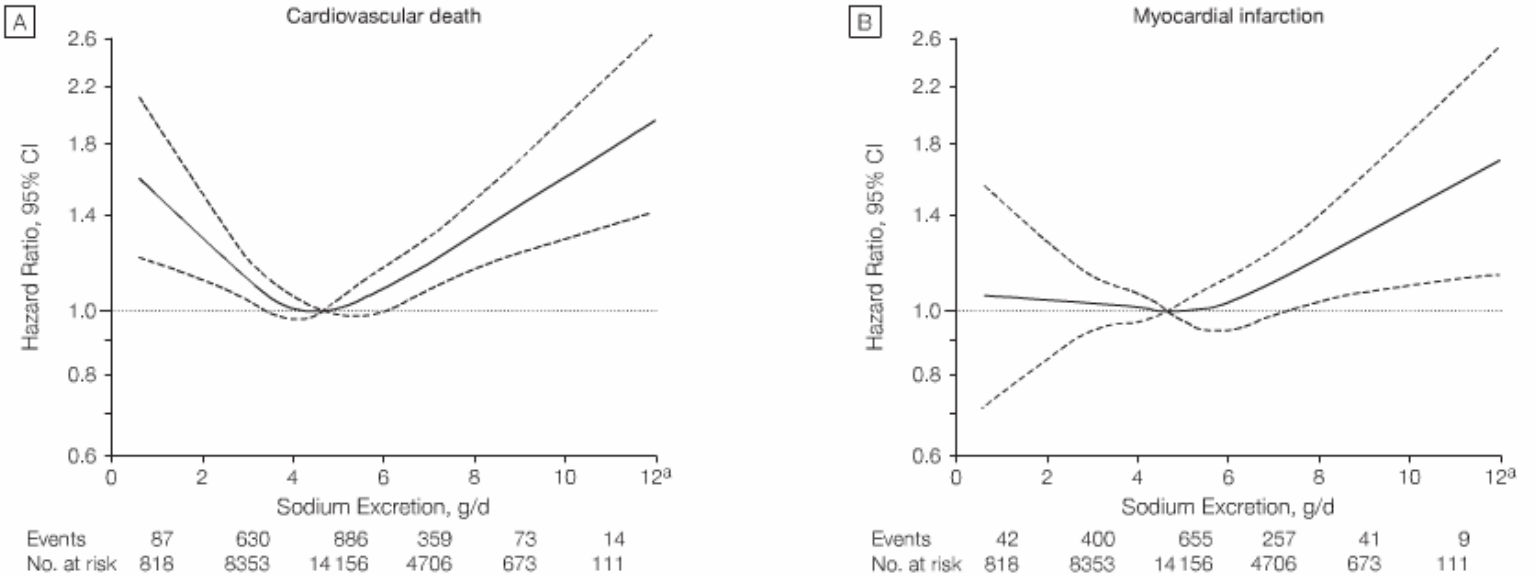
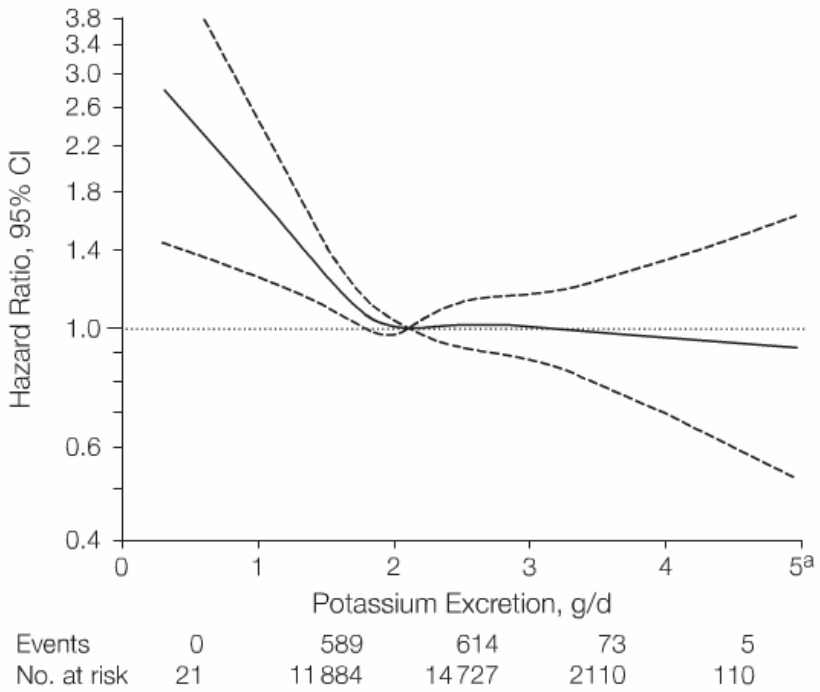

A
Cardiovascular death
Hazard Ratio, 95% CI
2.6
2.2
1.8
1.4
1.0
0.8
0.6
0 2 4 6 8 10 12[a]
Sodium Excretion, g/d
Events 87 630 886 359 73 14
No. at risk 818 8353 14 156 4706 673 111
B
Myocardial infarction
Hazard Ratio, 95% CI
2.6
2.2
1.8
1.4
1.0
0.8
0.6
0 2 4 6 8 10 12[a]
Sodium Excretion, g/d
Events 42 400 655 257 41 9
No. at risk 818 8353 14 156 4706 673 111
C
Congestive heart failure
Hazard Ratio, 95% CI
2.6
2.2
1.8
1.4
1.0
0.8
0.6
0 2 4 6 8 10 12[a]
Sodium Excretion, g/d
Events 52 379 532 195 37 11
No. at risk 818 8353 14 156 4706 673 111
D
Stroke
Hazard Ratio, 95% CI
2.6
2.2
1.8
1.4
1.0
0.8
0.6
0 2 4 6 8 10 12[a]
Sodium Excretion, g/d
Events 40 380 601 205 44 8
No. at risk 818 8353 14 156 4706 673 111

Figure 3. Estimated 24-Hour Urinary Excretion of Potassium and Stroke



Spline plot for adjusted Cox models. Median excretion is the reference standard. Model adjusted for age, sex, race/ethnicity (white vs nonwhite); prior history of stroke or myocardial infarction; creatinine, body mass index; comorbid vascular risk factors (hypertension, diabetes mellitus, atrial fibrillation, smoking, low- and high-density lipoprotein); treatment allocation (ramipril, telmisartan, neither, or both); treatment with statins, β-blockers, diuretic therapy, calcium antagonist, and antithrombotic therapy; fruit and vegetable consumption, level of exercise; baseline blood pressure and change in systolic blood pressure from baseline to last follow-up, and urinary sodium. Dashed lines indicate 95% CIs. Events and numbers at risk are shown between values on x-axis because they indicate the numeric range between these values.

[a] Spline curve truncated at 5 g per day (29 participants had potassium excretion >5 g/d, event rate 1/29).

DIABETIC PATIENTS

Dietary Salt Intake and Mortality in Patients With Type 2 Diabetes

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OBJECTIVE—Many guidelines recommend that patients with type 2 diabetes should aim to reduce their intake of salt. However, the precise relationship between dietary salt intake and mortality in patients with type 2 diabetes has not been previously explored.

RESEARCH DESIGN AND METHODS—Six hundred and thirty-eight patients attending a single diabetes clinic were followed in a prospective cohort study. Baseline sodium excretion was estimated from 24-h urinary collections ($24hU_{Na}$). The predictors of all-cause and cardiovascular mortality were determined by Cox regression and competing risk modeling, respectively.

RESULTS—The mean baseline $24hU_{Na}$ was 184 ± 73 mmol/24 h, which remained consistent throughout the follow-up (intraindividual coefficient of variation [CV] 23 ± 11%). Over a median of 9.9 years, there were 175 deaths, 75 (43%) of which were secondary to cardiovascular events. All-cause mortality was inversely associated with $24hU_{Na}$, after adjusting for other baseline risk factors ($P < 0.001$). For every 100 mmol rise in $24hU_{Na}$, all-cause mortality was 28% lower (95% CI 6–45%, $P = 0.02$). After adjusting for the competing risk of noncardiovascular death and other predictors, $24hU_{Na}$ was also significantly associated with cardiovascular mortality (sub-hazard ratio 0.65 [95% CI 0.44–0.95]; $P = 0.03$).

CONCLUSIONS—In patients with type 2 diabetes, lower 24-h urinary sodium excretion was paradoxically associated with increased all-cause and cardiovascular mortality. Interventional studies are necessary to determine if dietary salt has a causative role in determining adverse outcomes in patients with type 2 diabetes and the appropriateness of guidelines advocating salt restriction in this setting.

However, there is also evidence that reduced sodium intake is associated with activation of metabolic and neurohormonal pathways, including the sympathetic nervous system (4) and the renin-angiotensin-aldosterone system (RAAS) (4), as well as increases in total and LDL cholesterol (4) and reduced peripheral insulin sensitivity (5). In the context of type 2 diabetes, each of these factors may offset or even outweigh gains achieved from blood pressure lowering. Hence, in this study we explored the association between dietary salt intake, the best estimate of which is 24-h urine collection as ~90% of dietary sodium intake is renally excreted (6), and all-cause and cardiovascular mortality in patients with type 2 diabetes.

RESEARCH DESIGN AND METHODS

Patient recruitment

This study was initiated in July 2000 as a prospective survey of patients with type 2 diabetes who were in long-term follow-up in a single diabetes clinic at Austin Health,

Table 1—*Baseline characteristics of patients with type 2 diabetes, stratified according to tertiles (T) of 24-h urinary sodium excretion*

Baseline parameter	T1 <150 mmol/24 h	T2 150–208 mmol/24 h	T3 >208 mmol/24 h
Age (years)	67 ± 12*	64 ± 11	61 ± 12*
Sex (% male)	42*	56	70*
Diabetes duration (years)	14 ± 9*	12 ± 8	11 ± 8
Obese (BMI >30 kg/m^2) (%)	41	45	55*
Macrovascular disease (%)	49	43	44
Coronary heart disease (%)	34	32	37
Atrial fibrillation (%)	20	20	12*
Congestive cardiac failure (%)	17	11	15
C-reactive protein (geometric mean; IU/mL)	2.4	2.1	2.6
Systolic blood pressure (mmHg)	141 ± 17	140 ± 17	140 ± 16
Diastolic blood pressure (mmHg)	77 ± 10*	80 ± 9	78 ± 10*
Antihypertensive therapy (%)	78	78	76
ACE inhibitor (%)	45*	56	57
Angiotensin receptor blocker (%)	13	13	10
Diuretic (%)	38	32	42
β-Blocker (%)	23*	15	20
Calcium channel blocker (%)	34	28	34
α-Blocker (%)	5	5	5
HbA_{1c} (%)	7.8 ± 1.7	7.8 ± 1.3	7.7 ± 1.5
Fasting plasma glucose (mmol/L)	9.6 ± 4.0	9.3 ± 3.2	9.3 ± 3.7
Metformin (%)	50	57	58
Sulfonylurea (%)	37*	51	40*
Insulin (%)	49%*	36%	39%
LDL cholesterol (mmol/L)	2.6 ± 0.8	2.7 ± 0.8	2.6 ± 0.8
Triglycerides (mmol/L)	2.0 ± 1.8	2.0 ± 1.4	2.2 ± 1.6
HDL cholesterol (mmol/L)	1.2 ± 0.4	1.2 ± 0.3	1.1 ± 0.3
Statin (%)	53	52	49
eGFR (mL/min/1.73 m^2)	67 ± 26*	73 ± 25	78 ± 24*
Albuminuria (micro and macro, %)	42	42	50
Hemoglobin (g/dL)	13.2 ± 1.5	13.4 ± 1.5	13.7 ± 1.5*

Data are mean ± SD unless otherwise indicated. *$P < 0.01$ vs. middle tertile (T2).

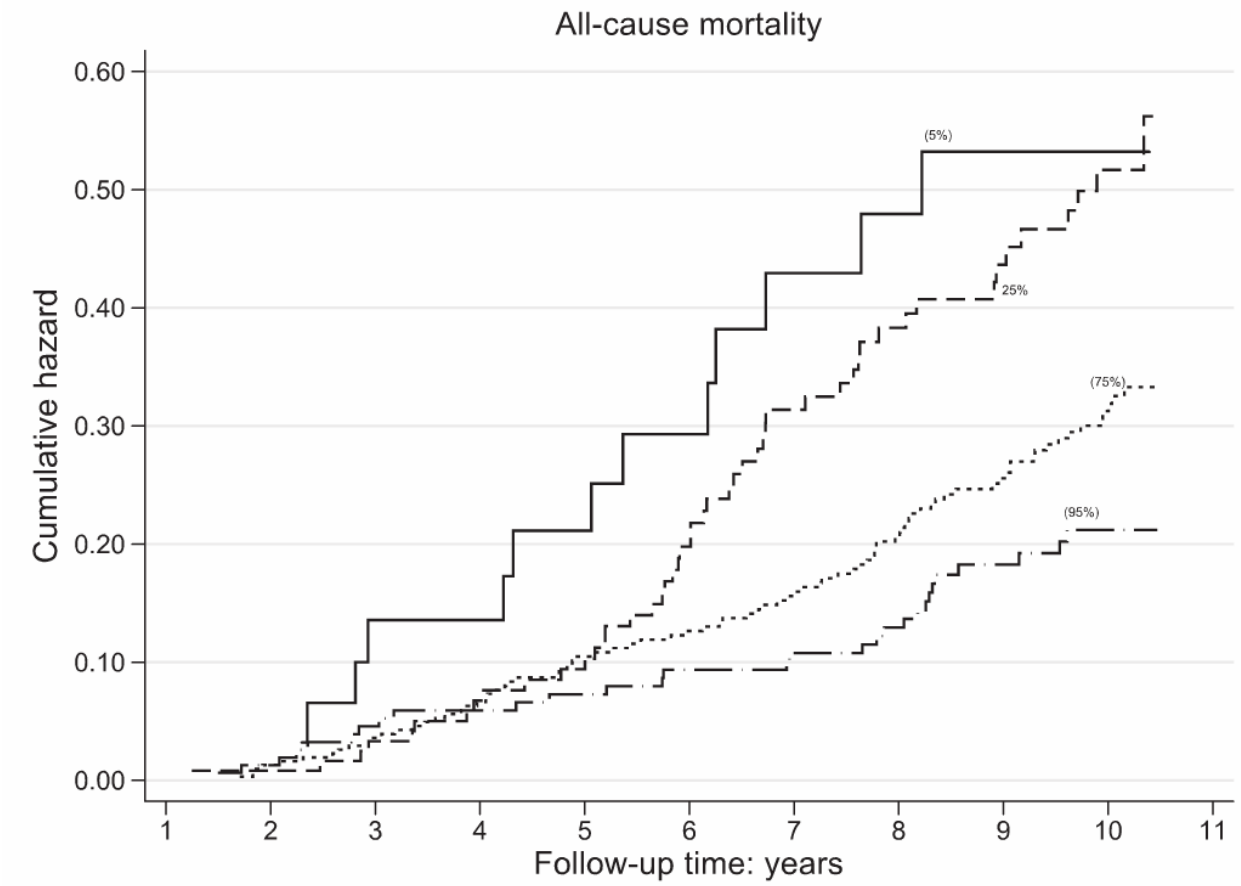

Figure 1—*Cumulative hazard (Nelson-Aalen) of all-cause mortality, stratified by percentiles (5th, 25th, 75th, and 95th) of 24-h urinary sodium excretion. All-cause mortality was inversely associated with 24-h urinary sodium excretion.*

Table 2—*Independent associations with all-cause mortality and cumulative incidence of cardiovascular mortality in individuals with type 2 diabetes*

All-cause mortality			
Baseline parameter	Hazard ratio	*P*	95% CI
24-h urinary sodium excretion (per 100 mmol/day)	0.72	0.017	0.55–0.94
Age (per decade)	1.05	<0.001	1.03–1.07
Male sex (yes/no)	1.51	0.013	1.09–2.09
Pre-existing CVD (yes/no)	1.85	0.001	1.30–2.64
eGFR (per 10 mL/min/1.73 m^2)	0.988	0.002	0.980–0.996
Atrial fibrillation (yes/no)	1.97	<0.001	1.39–2.81
Log_{10} AER	1.71	<0.001	1.38–2.12
Systolic blood pressure (mmHg)	0.986	0.015	0.974–0.997
Diabetes duration (decades)	1.02	0.010	1.01–1.04

Cardiovascular mortality			
Baseline parameter	Sub-hazard ratio	*P*	95% CI
24-h urinary sodium excretion (per 100 mmol/day)	0.65	0.026	0.44–0.95
Male sex (yes/no)	1.93	0.011	1.17–3.20
Pre-existing CVD (yes/no)	1.88	0.014	1.14–3.11
eGFR (per 10 mL/min/1.73 m^2)	0.985	0.001	0.98–0.99
Atrial fibrillation (yes/no)	2.78	<0.001	1.71–4.53
Log_{10} AER	1.76	<0.001	1.28–2.42
Systolic blood pressure (mmHg)	0.97	<0.001	0.96–0.99
Diabetes duration (decades)	1.05	<0.001	1.02–1.08

All-cause mortality: independent associations with all-cause mortality in individuals with type 2 diabetes in a multivariate Cox model. The model explained 52% of the variation in all-cause mortality (95% CI 0.42–0.64) and was well specified (Harrell's C: 0.79; PH test: $P = 0.136$; goodness-of-fit test: $P \geq 0.37$). PH, proportional hazard. Cardiovascular mortality: independent associations with the cumulative incidence of cardiovascular mortality in individuals with type 2 diabetes in the Fine and Gray (proportional hazards) model after accounting for the competing risk of noncardiovascular death.

HEALTHY VOLUNTEERS

METABOLISM CLINICAL AND EXPERIMENTAL 60 (2011) 965–968

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Low-salt diet increases insulin resistance in healthy subjects

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Table 1 – Comparison of subject characteristics and laboratory parameters on HS vs LS diet

	LS diet	HS diet	*P*
BMI (kg/m^2)	24.6 ± 4.1	25.3 ± 4.1	<.0001
Mean arterial blood pressure (mm Hg)	78.1 ± 8.2	82.6 ± 9.2	<.0001
Serum Na (mmol/L)	139.0 ± 5.4	140.0 ± 5.3	NS
Serum K (mmol/L)	4.1 ± 0.4	4.1 ± 0.4	NS
Serum cortisol (μg/dL)	12.3 ± 4.4	11.9 ± 4.1	NS
Serum aldosterone (ng/dL)	21.0 ± 13.5	3.4 ± 1.4	<.0001
PRA (ng/[mL h])	3.1 ± 2.1	0.39 ± 0.40	<.0001
Angiotensin II (pg/mL)	43.9 ± 22.6	28.1 ± 15.9	<.0001
Serum aldosterone after angiotensin II infusion (ng/dL)	45.2 ± 21.8	11.2 ± 6.6	<.0001
Urine Na (mmol/d)	7.5 ± 4.9	237.8 ± 70.9	<.0001
Urine aldosterone (μg/d)	63.0 ± 34.0	9.6 ± 6.5	<.0001
Urine cortisol (μg/d)	37.4 ± 24.4	52.7 ± 25.9	<.0001
Urine epinephrine (μg/d)	11.5 ± 6.3	12.2 ± 6.5	NS
Urine norepinephrine (μg/d)	78.0 ± 36.7	67.9 ± 39.8	<.05
Urine creatinine (mg/d)	1367 ± 408	1401 ± 397	NS
HOMA	2.82 ± 1.6	2.45 ± 1.69	.002

IOM REPORT

REPORT BRIEF MAY 2013

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Sodium Intake in Populations

Assessment of Evidence

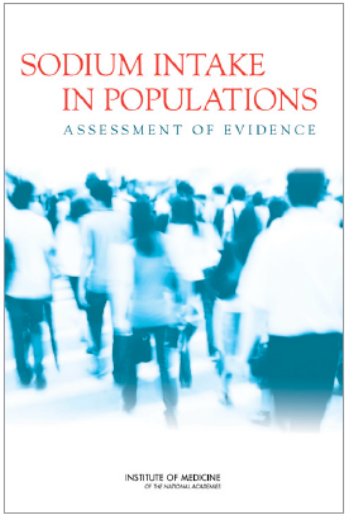


TABLE E-1 Example (MedLine) of Searches to Identify Relevant Literature on Sodium Intake and Health Outcomes

Search No.	Search Terms	Number of Hits
1	Sodium, Dietary/or Sodium Chloride, Dietary/or Diet, Sodium-Restricted/	4,022
2	1 and (health or disease$ or condition$). mp. [mp=title, abstract, original title, name of substance word, subject heading word, protocol supplementary concept, rare disease supplementary concept, unique identifier]	1,936
3	1 and hypertension/	1,445
4	1 and (cardiovascular diseases/or coronary disease/or death, sudden/)	289
5	1 and heart failure/	130
6	1 and mortality/	10
7	1 and stroke/	80
8	1 and (fractures, bones/or accidental falls/)	1
9	1 and myocardial infarction/	22
10	1 and headache/	3
11	1 and kidney calculi/	17
12	1 and skin manifestations/	0
13	1 and thyroid diseases/	28
14	1 and immunity/	0
15	1 and diabetes mellitus/	21
16	1 and (kidney failure, chronic/or kidney diseases/)	242
17	1 and neoplasms/	13
	Total	2,687
	Total without animal or in vitro studies	1,938

Implications for population-based strategies

With regard to implications for population-based efforts, the committee finds that:

- The available evidence on associations between sodium intake and direct health outcomes is consistent with population-based efforts to lower excessive dietary sodium intakes.
- The evidence on health outcomes is not consistent with efforts that encourage lowering of dietary sodium in the general population to 1,500 mg/day.
- There is no evidence on health outcomes to support treating population subgroups differently from the general U.S. population.

COCHRANE REVIEW

Reduced dietary salt for the prevention of cardiovascular disease (Review)

Adler AJ, Taylor F, Martin N, Gottlieb S, Taylor RS, Ebrahim S

THE COCHRANE COLLABORATION®

Analysis 1.1. Comparison 1 Reduced salt versus control, Outcome 1 All-cause mortality at end of trial.

Review: Reduced dietary salt for the prevention of cardiovascular disease

Comparison: 1 Reduced salt versus control

Outcome: 1 All-cause mortality at end of trial

Study or subgroup	Intervention n/N	Control n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
1 Normotensive					
HPT 1990	1/196	1/196		0.3 %	1.00 [0.06, 15.87]
TOHP I 1992	6/327	12/417		3.5 %	0.64 [0.24, 1.68]
TOHP II 1997	16/1191	24/1191		7.9 %	0.67 [0.36, 1.25]
Subtotal (95% CI)	**1714**	**1804**		**11.6 %**	**0.67 [0.40, 1.12]**
Total events: 23 (Intervention), 37 (Control)					
Heterogeneity: $Chi^2 = 0.09$, df = 2 (P = 0.96); $I^2 = 0.0\%$					
Test for overall effect: Z = 1.53 (P = 0.13)					
2 Hypertensive					
Chang 2006	192/768	312/1213		79.1 %	0.97 [0.83, 1.14]
CSSS 2007	4/302	4/306		1.3 %	1.01 [0.26, 4.01]
Kwok 2012	27/204	25/225		7.8 %	1.19 [0.72, 1.98]
Morgan 1978	1/34	0/33		0.2 %	2.91 [0.12, 69.08]
Subtotal (95% CI)	**1308**	**1777**		**88.4 %**	**1.00 [0.86, 1.15]**
Total events: 224 (Intervention), 341 (Control)					
Heterogeneity: $Chi^2 = 1.01$, df = 3 (P = 0.80); $I^2 = 0.0\%$					

Analysis 1.2. Comparison 1 Reduced salt versus control, Outcome 2 All-cause mortality at longest follow-up.

Review: Reduced dietary salt for the prevention of cardiovascular disease

Comparison: 1 Reduced salt versus control

Outcome: 2 All-cause mortality at longest follow-up

Study or subgroup	Intervention n/N	Control n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
1 Normotensive					
HPT 1990	1/196	1/196		2.4 %	1.00 [0.06, 15.87]
TOHP I 1992	10/327	14/417		29.8 %	0.91 [0.41, 2.02]
TOHP II 1997	25/1191	28/1191		67.8 %	0.89 [0.52, 1.52]
Subtotal (95% CI)	**1714**	**1804**		**100.0 %**	**0.90 [0.58, 1.40]**
Total events: 36 (Intervention), 43 (Control)					
Heterogeneity: $Chi^2 = 0.01$, df = 2 (P = 1.00); I^2 =0.0%					
Test for overall effect: Z = 0.47 (P = 0.64)					
2 Hypertensive					
Chang 2006	192/768	312/1213		74.6 %	0.97 [0.83, 1.14]
CSSS 2007	4/302	4/306		1.2 %	1.01 [0.26, 4.01]
Kwok 2012	27/204	25/225		7.3 %	1.19 [0.72, 1.98]
Morgan 1978	4/35	5/42		1.4 %	0.96 [0.28, 3.30]
TONE 1998	51/294	50/291		15.5 %	1.01 [0.71, 1.44]

Analysis 1.3. Comparison 1 Reduced salt versus control, Outcome 3 Cardiovascular mortality at end of trial.

Review: Reduced dietary salt for the prevention of cardiovascular disease

Comparison: 1 Reduced salt versus control

Outcome: 3 Cardiovascular mortality at end of trial

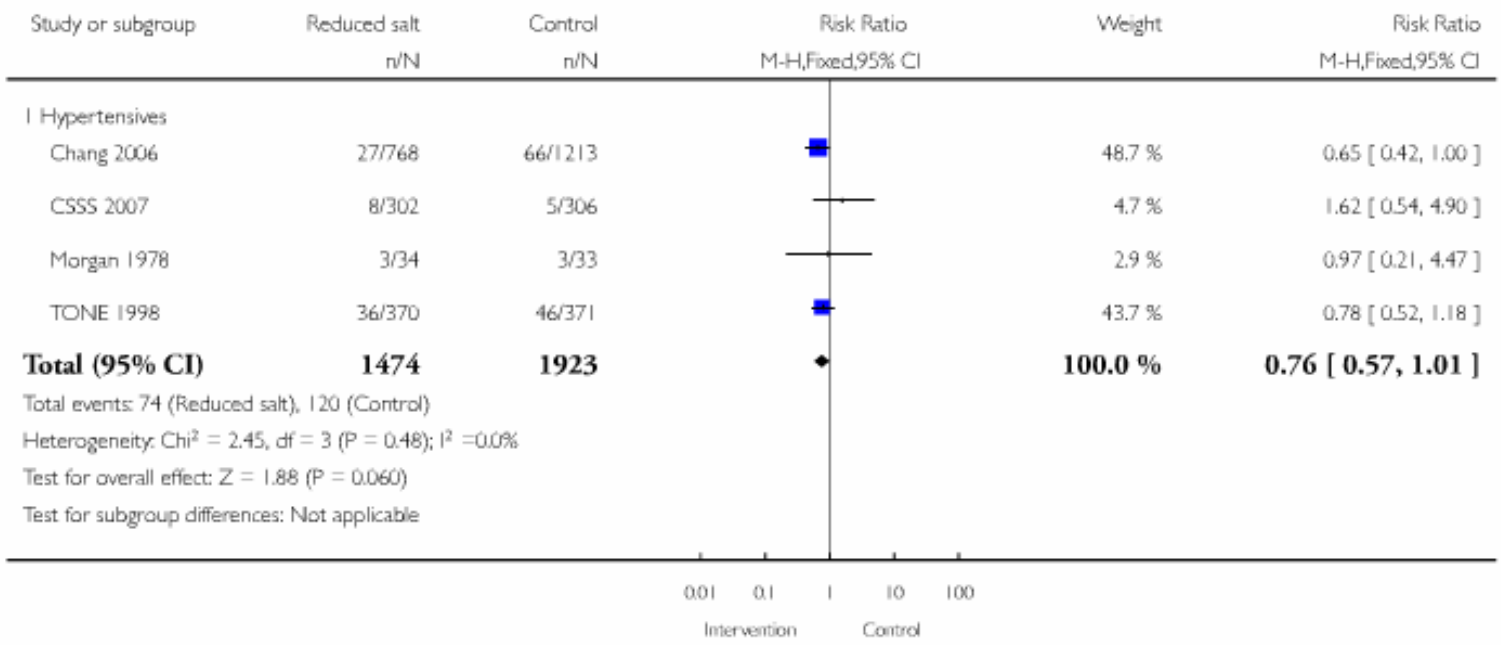
Study or subgroup	Intervention n/N	Control n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
1 Hypertensive					
Chang 2006	27/768	66/1213		88.1 %	0.65 [0.42, 1.00]
CSSS 2007	4/302	4/306		6.8 %	1.01 [0.26, 4.01]
Morgan 1978	2/33	3/34		5.1 %	0.69 [0.12, 3.85]
Subtotal (95% CI)	**1103**	**1553**		**100.0 %**	**0.67 [0.45, 1.01]**
Total events: 33 (Intervention), 73 (Control)					
Heterogeneity: $Chi^2 = 0.37$, $df = 2$ ($P = 0.83$); $I^2 = 0.0\%$					
Test for overall effect: $Z = 1.91$ ($P = 0.056$)					

Analysis 1.4. Comparison 1 Reduced salt versus control, Outcome 4 Cardiovascular events at end of trial.

Review: Reduced dietary salt for the prevention of cardiovascular disease

Comparison: 1 Reduced salt versus control

Outcome: 4 Cardiovascular events at end of trial



Main results

Eight studies met the inclusion criteria: three in normotensives (n = 3518) and five in hypertensives or mixed populations of normo- and hypertensives (n = 3766). End of trial follow-up ranged from six to 36 months and the longest observational follow-up (after trial end) was 12.7 years.

The risk ratios (RR) for all-cause mortality in normotensives were imprecise and showed no evidence of reduction (end of trial RR 0.67, 95% confidence interval (CI) 0.40 to 1.12, 60 deaths; longest follow-up RR 0.90, 95% CI 0.58 to 1.40, 79 deaths n=3518) or in hypertensives (end of trial RR 1.00, 95% CI 0.86 to 1.15, 565 deaths; longest follow-up RR 0.99, 95% CI 0.87 to 1.14, 674 deaths n=3085).

There was weak evidence of benefit for cardiovascular mortality (hypertensives: end of trial RR 0.67, 95% CI 0.45 to 1.01, 106 events n=2656) and for cardiovascular events (hypertensives: end of trial RR 0.76, 95% CI 0.57 to 1.01, 194 events, four studies, n = 3397; normotensives: at longest follow-up RR 0.71, 95% CI 0.42 to 1.20, 200 events; hypertensives: RR 0.77, 95% CI 0.57 to 1.02, 192 events; pooled analysis of six trials RR 0.77, 95% CI 0.63 to 0.95, n = 5912). These findings were driven by one trial among retirement home residents that reduced salt intake in the kitchens of the homes, thereby not requiring individual behaviour change.

Advice to reduce salt showed small reductions in systolic blood pressure (mean difference (MD) -1.15 mmHg, 95% CI -2.32 to 0.02 n=2079) and diastolic blood pressure (MD -0.80 mmHg, 95% CI -1.37 to -0.23 n=2079) in normotensives and greater reductions in systolic blood pressure in hypertensives (MD -4.14 mmHg, 95% CI -5.84 to -2.43 n=675), but no difference in diastolic blood pressure (MD -3.74 mmHg, 95% CI -8.41 to 0.93 n=675).

Authors' conclusions

Despite collating more event data than previous systematic reviews of randomised controlled trials, there is insufficient power to confirm clinically important effects of dietary advice and salt substitution on cardiovascular mortality in normotensive or hypertensive populations. Our estimates of the clinical benefits from advice to reduce dietary salt are imprecise, but are larger than would be predicted from the small blood pressure reductions achieved. Further well-powered studies would be needed to obtain more precise estimates. Our findings do not support individual dietary advice as a means of restricting salt intake. It is possible that alternative strategies that do not require individual behaviour change may be effective and merit further trials.

MOST RECENT NEJM PAPERS

Original Article

Association of Urinary Sodium and Potassium Excretion with Blood Pressure

Andrew Mente, Ph.D., Martin J. O'Donnell, M.B., Ph.D., Sumathy Rangarajan, M.Sc., Matthew J. McQueen, M.B., B.Ch., Paul Poirier, M.D., Ph.D., Andreas Wielgosz, M.D., Ph.D., Howard Morrison, Ph.D., Wei Li, Ph.D., Xingyu Wang, Ph.D., Chen Di, B.Sc., Prem Mony, M.D., Anitha Devanath, M.D., Annika Rosengren, M.D., Aytekin Oguz, M.D., Katarzyna Zatonska, M.D., Ph.D., Afzal Hussein Yusufali, M.D., Patricio Lopez-Jaramillo, M.D., Ph.D., Alvaro Avezum, M.D., Ph.D., Noorhassim Ismail, M.D., Ph.D., Fernando Lanas, M.D., Thandi Puoane, M.P.H., Ph.D., Rafael Diaz, M.D., Roya Kelishadi, M.D., Romaina Iqbal, Ph.D., Rita Yusuf, Ph.D., Jephat Chifamba, M.Phil., Rasha Khatib, M.H.S., Koon Teo, M.B., Ph.D., Salim Yusuf, D.Phil., for the PURE Investigators

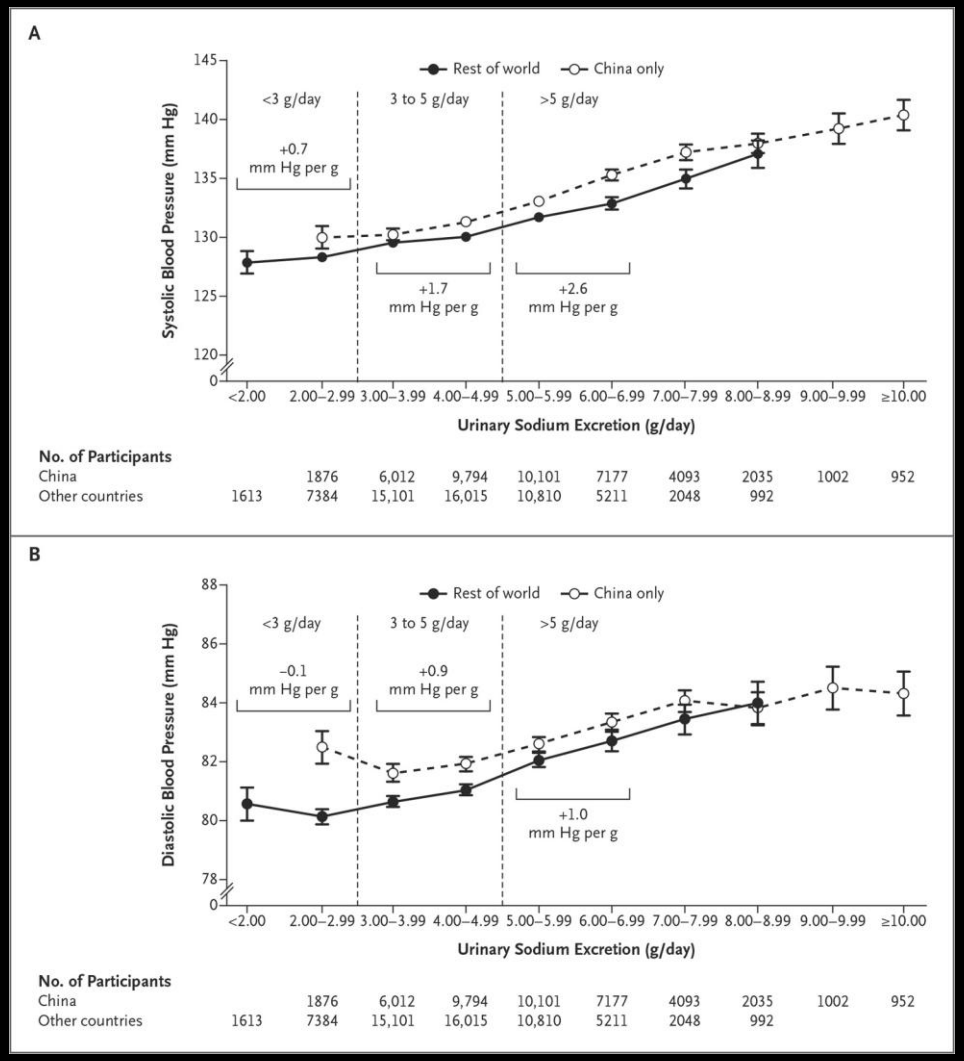
N Engl J Med
Volume 371(7):601-611
August 14, 2014

The NEW ENGLAND JOURNAL of MEDICINE

Study Overview

- In a large study in 18 countries, sodium and potassium intake were estimated from urine samples and correlated with blood pressure.
- The correlations were nonlinear and were most pronounced among people with high sodium intake, those with hypertension, and older persons.

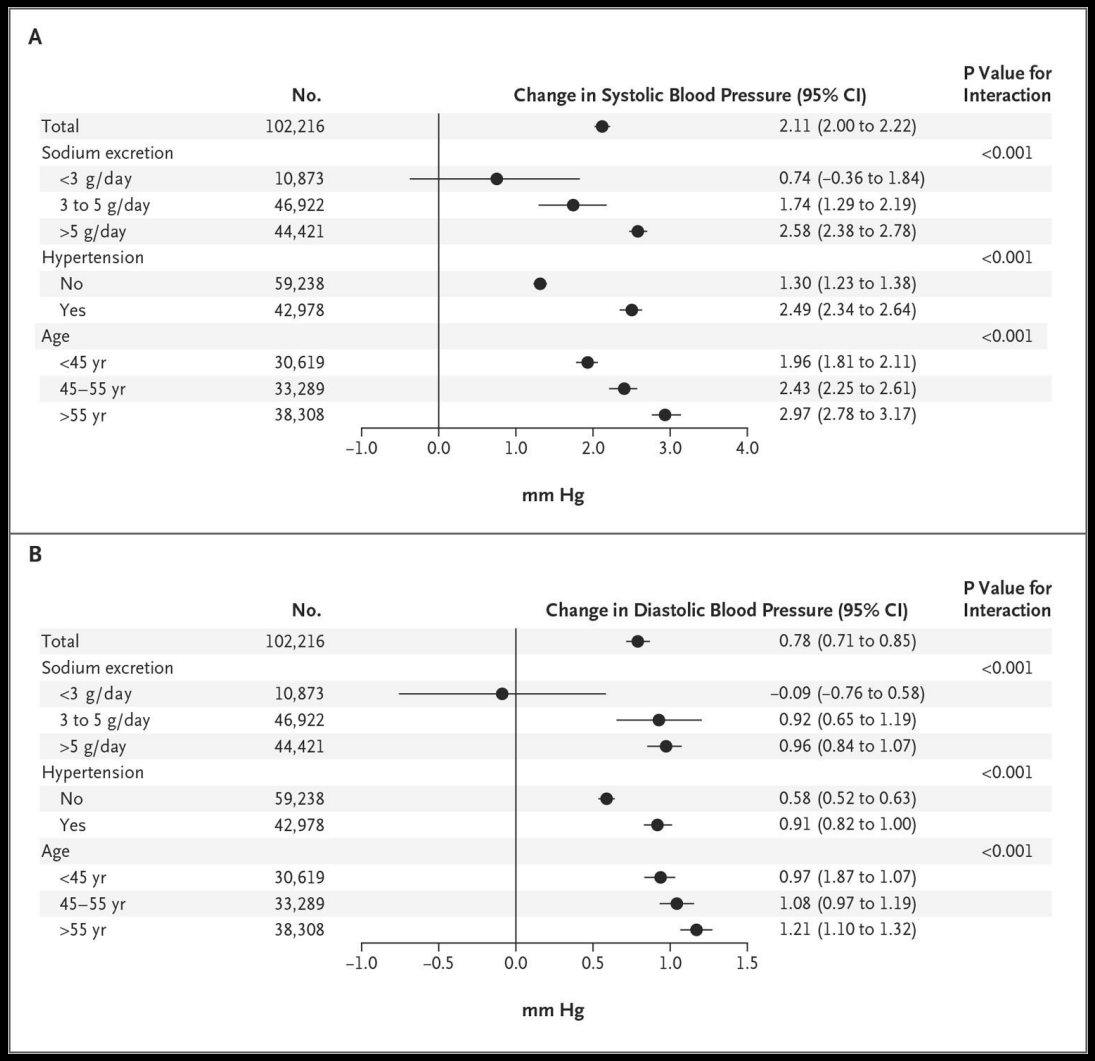
Mean Systolic and Diastolic Blood Pressure According to Sodium Excretion.



Mente A et al. N Engl J Med 2014;371:601-611

The NEW ENGLAND JOURNAL of MEDICINE

Forest Plots of Changes in Systolic and Diastolic Blood Pressure for Every 1-g Increase in Sodium Excretion.



Mente A et al. N Engl J Med 2014;371:601-611

The NEW ENGLAND JOURNAL of MEDICINE

Conclusions

- In this study, the association of estimated intake of sodium and potassium, as determined from measurements of excretion of these cations, with blood pressure was nonlinear and was most pronounced in persons consuming high-sodium diets, persons with hypertension, and older persons.

Original Article

Urinary Sodium and Potassium Excretion, Mortality, and Cardiovascular Events

Martin O'Donnell, M.B., Ph.D., Andrew Mente, Ph.D., Sumathy Rangarajan, M.Sc., Matthew J. McQueen, M.B., Ph.D., Xingyu Wang, Ph.D., Lisheng Liu, M.D., Hou Yan, Ph.D., Shun Fu Lee, Ph.D., Prem Mony, M.D., Anitha Devanath, M.D., Annika Rosengren, M.D., Patricio Lopez-Jaramillo, M.D., Ph.D., Rafael Diaz, M.D., Alvaro Avezum, M.D., Ph.D., Fernando Lanas, M.D., Khalid Yusoff, M.B., B.S., Romaina Iqbal, Ph.D., Rafal Ilow, Ph.D., Noushin Mohammadifard, M.Sc., Sadi Gulec, M.D., Afzal Hussein Yusufali, M.D., Lanthe Kruger, Ph.D., Rita Yusuf, Ph.D., Jephat Chifamba, M.Phil., Conrad Kabali, Ph.D., Gilles Dagenais, M.D., Scott A. Lear, Ph.D., Koon Teo, M.B., Ph.D., Salim Yusuf, D.Phil., for the PURE Investigators

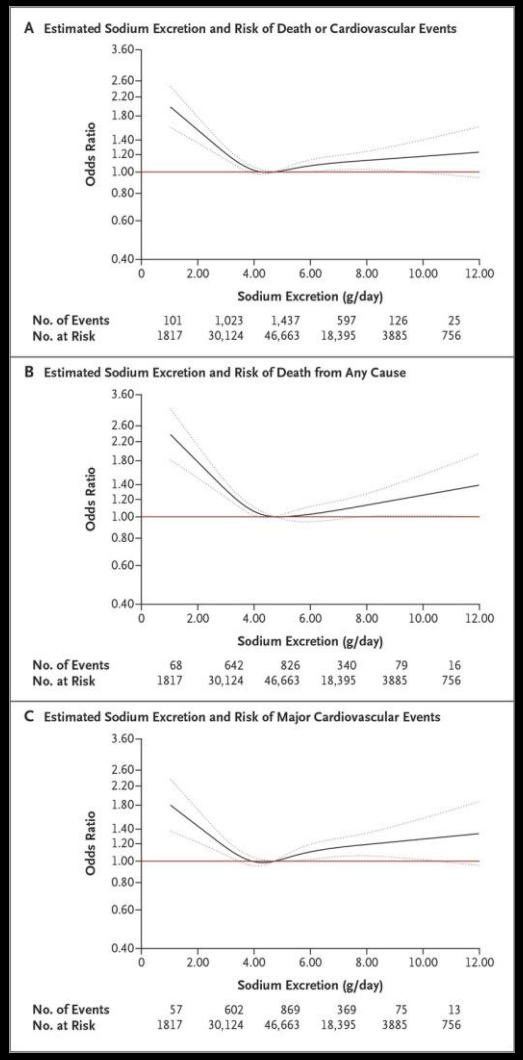
N Engl J Med
Volume 371(7):612-623
August 14, 2014

The NEW ENGLAND JOURNAL of MEDICINE

Study Overview

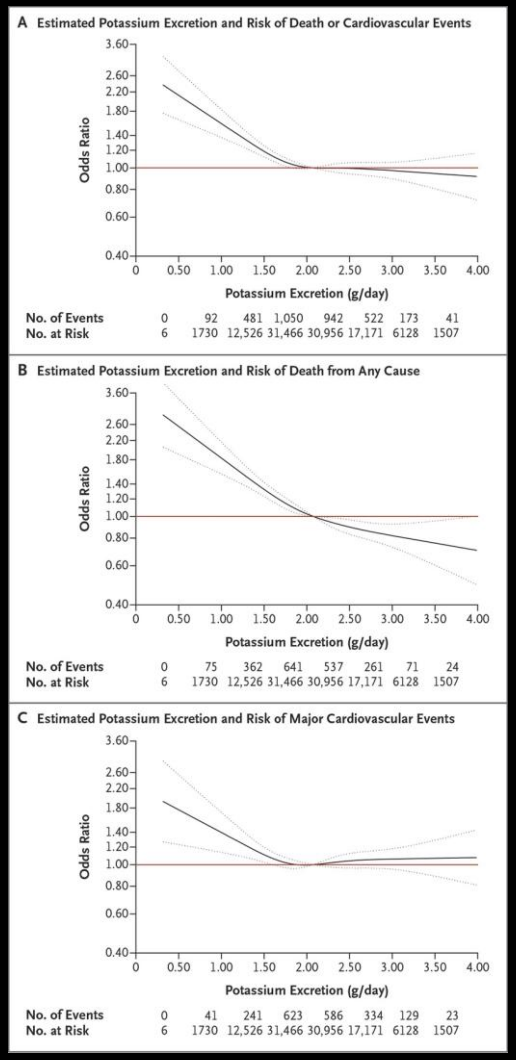
- In a large study in 17 countries, an estimated sodium intake that was either higher or lower than the average estimated sodium intake was associated with an increased risk of cardiovascular events.
- A higher-than-average potassium intake was associated with reduced risk.

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



O'Donnell M et al. N Engl J Med 2014;371:612-623

Association of Estimated 24-Hour Urinary Potassium Excretion with Risk of Death and Major Cardiovascular Events.



O'Donnell M et al. N Engl J Med 2014;371:612-623

Association of Estimated Urinary Sodium Excretion with Death and Major Cardiovascular Events.

Table 2. Association of Estimated Urinary Sodium Excretion with Death and Major Cardiovascular Events.*

Variable	Estimated Sodium Excretion				
	<3.00 g/day (N=10,810)	3.00–3.99 g/day (N=21,131)	4.00–5.99 g/day (N=46,663)	6.00–6.99 g/day (N=12,324)	≥7.00 g/day (N=11,017)
Death or cardiovascular event — no. of participants (%)	462 (4.3)	662 (3.1)	1437 (3.1)	391 (3.2)	365 (3.3)
Analysis — odds ratio (95% CI)					
Univariate analysis†	1.24 (1.09–1.41)	0.96 (0.89–1.05)	1.00	1.07 (0.96–1.19)	1.18 (1.05–1.32)
Multivariate analysis					
Primary analysis‡	1.27 (1.12–1.44)	1.01 (0.93–1.09)	1.00	1.05 (0.94–1.17)	1.15 (1.02–1.30)
Analysis including LDL:HDL ratio	1.30 (1.15–1.48)	1.00 (0.92–1.09)	1.00	1.06 (0.94–1.19)	1.18 (1.04–1.33)
Analysis including dietary factors§	1.19 (1.04–1.35)	1.00 (0.92–1.09)	1.00	1.06 (0.95–1.18)	1.15 (1.02–1.30)
Analysis including dietary factors and blood pressure¶	1.19 (1.05–1.36)	1.01 (0.93–1.10)	1.00	1.03 (0.92–1.15)	1.08 (0.96–1.22)
Analysis excluding cardiovascular disease at baseline‖	1.24 (1.07–1.42)	1.00 (0.91–1.10)	1.00	1.06 (0.95–1.19)	1.14 (1.01–1.29)
Analysis excluding cancer‖	1.26 (1.11–1.43)	1.02 (0.93–1.11)	1.00	1.06 (0.95–1.18)	1.15 (1.02–1.29)
Very-low-risk cohort‖**	1.62 (1.29–2.05)	1.07 (0.90–1.26)	1.00	1.15 (0.98–1.35)	1.14 (0.95–1.36)
Analysis excluding events in yr 1‖	1.33 (1.17–1.52)	1.02 (0.93–1.13)	1.00	1.12 (0.99–1.27)	1.16 (1.01–1.33)
Analysis excluding events in yr 1 and 2‖	1.34 (1.14- 1.57)	1.04 (0.93–1.16)	1.00	1.15 (1.00–1.32)	1.11 (0.96–1.28)

* Major cardiovascular events included death from cardiovascular causes, myocardial infarction, stroke, and heart failure.
† The univariate analysis was performed with the use of a generalized-estimating-equation model to address clustering of data.
‡ The primary model included age, sex, educational level, ancestry (Asian vs. non-Asian), alcohol intake, body-mass index, and status with respect to diabetes mellitus, a history of cardiovascular events, and current smoking. Additional sensitivity analyses with physical activity (measured in metabolic equivalents per week) included in the model did not materially alter estimates of association (in the cohort with physical-activity data available).
§ Dietary variables included caloric intake, potassium intake, and fruit and vegetable intake.
¶ Blood-pressure variables included baseline systolic blood pressure, history of hypertension (yes or no), and use of antihypertensive therapy (yes or no).
‖ The analysis was adjusted for the variables in the primary model.
** The very-low-risk cohort included 57,988 participants and excluded participants who had prior cardiovascular disease, who had been prescribed medications for cardiovascular disease, who had a history of cancer or a diagnosis of cancer on follow-up, who were smokers, or who had diabetes.

O'Donnell M et al. N Engl J Med 2014;371:612-623

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Conclusions

- In this study in which sodium intake was estimated on the basis of measured urinary excretion, an estimated sodium intake between 3 g per day and 6 g per day was associated with a lower risk of death and cardiovascular events than was either a higher or lower estimated level of intake.
- As compared with an estimated potassium excretion that was less than 1.50 g per day, higher potassium excretion was associated with a lower risk of death and cardiovascular events.

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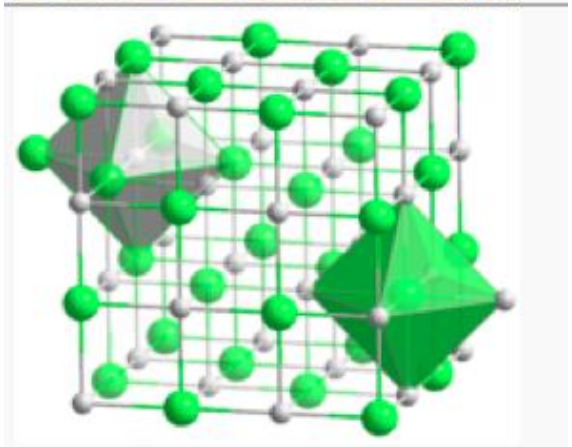
THE WRONG WHITE CRYSTAL

NaCl



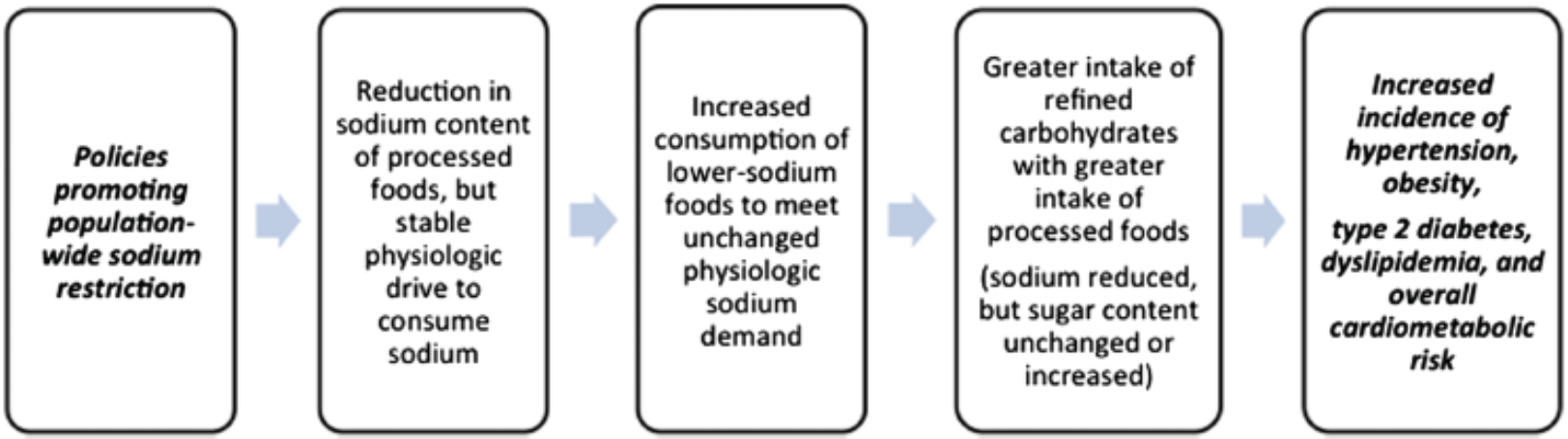
Sucrose

openheart

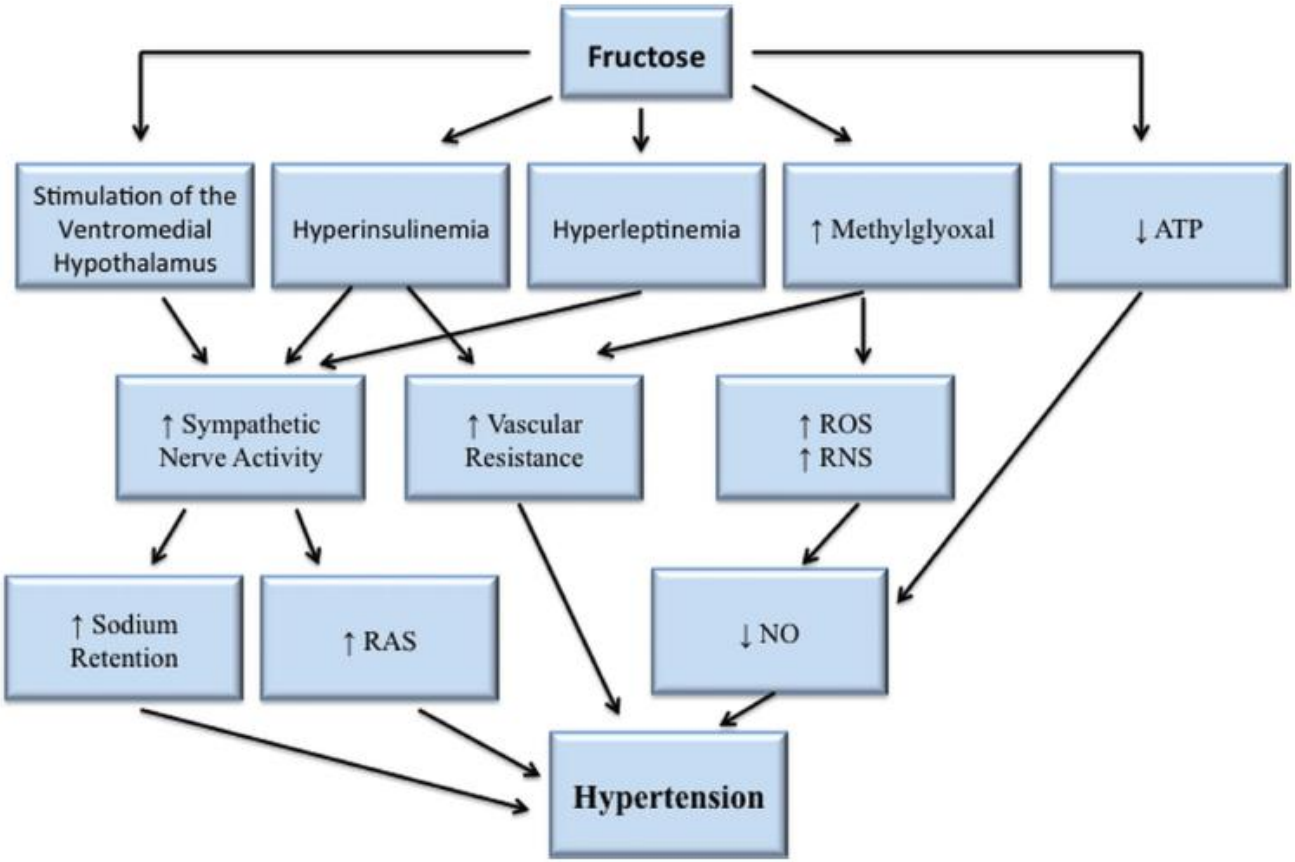
The wrong white crystals: not salt but sugar as aetiological in hypertension and cardiometabolic disease

James J DiNicolantonio,[1] Sean C Lucan[2]

Unintended consequences of population-wide sodium restriction

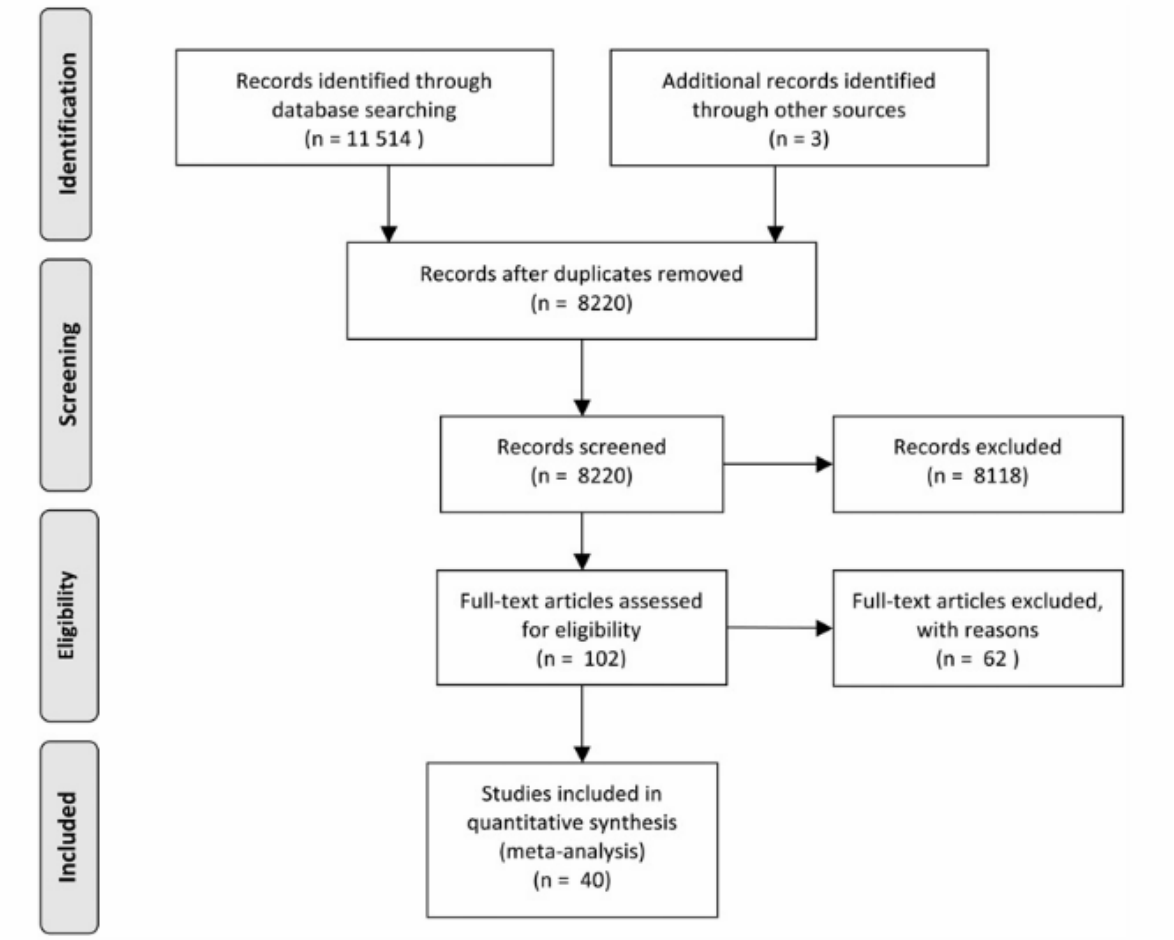


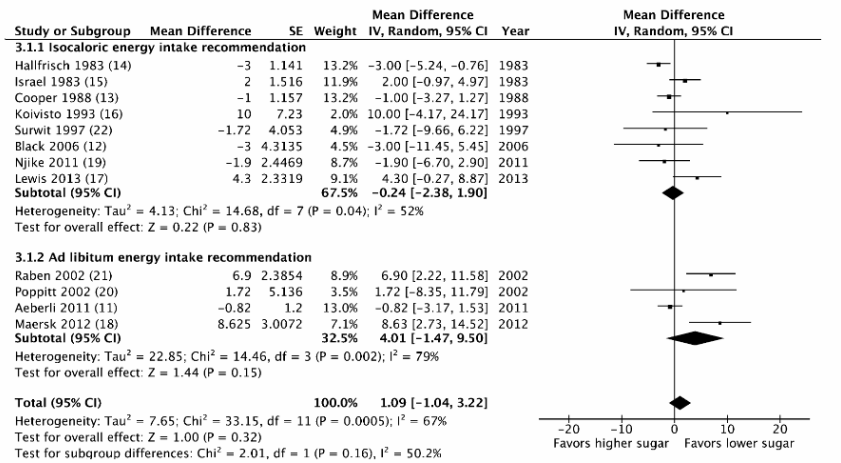
DiNicolantonio JJ, Lucan SC. *Open Heart* 2014;**1**:e000167. doi:10.1136/openhrt-2014-000167

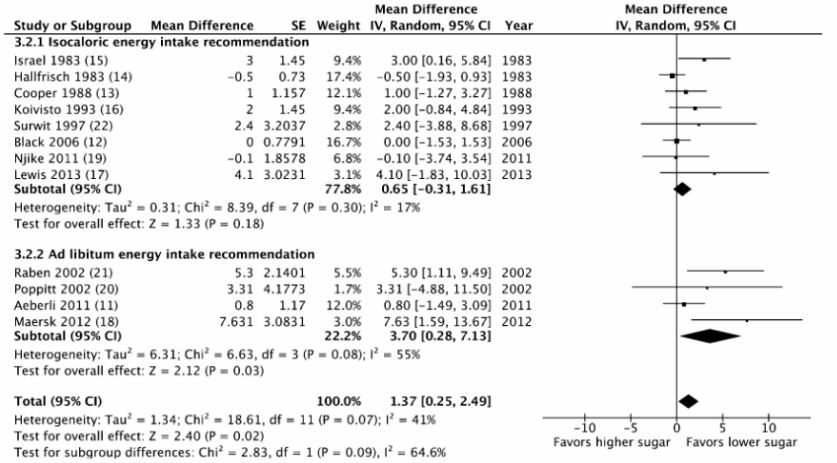

Fructose
Stimulation of the Ventromedial Hypothalamus
Hyperinsulinemia
Hyperleptinemia
↑ Methylglyoxal
↓ ATP
↑ Sympathetic Nerve Activity
↑ Vascular Resistance
↑ ROS
↑ RNS
↑ Sodium Retention
↑ RAS
↓ NO
Hypertension

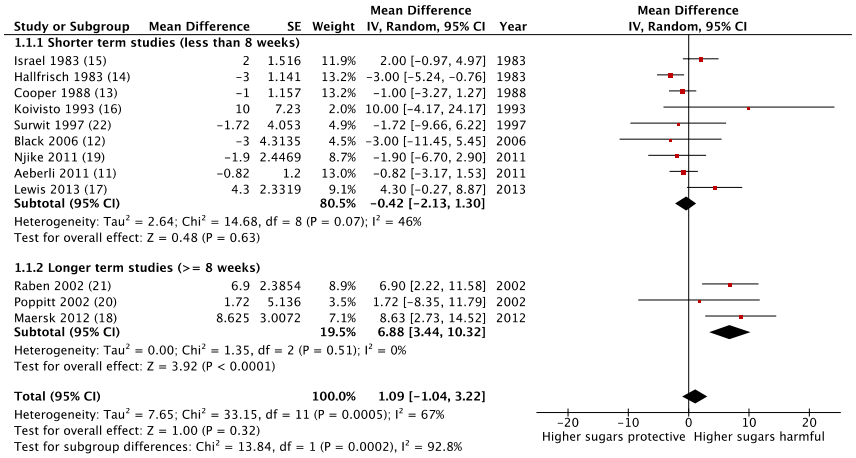
Dietary sugars and cardiometabolic risk: systematic review and meta-analyses of randomized controlled trials of the effects on blood pressure and lipids[1–3]

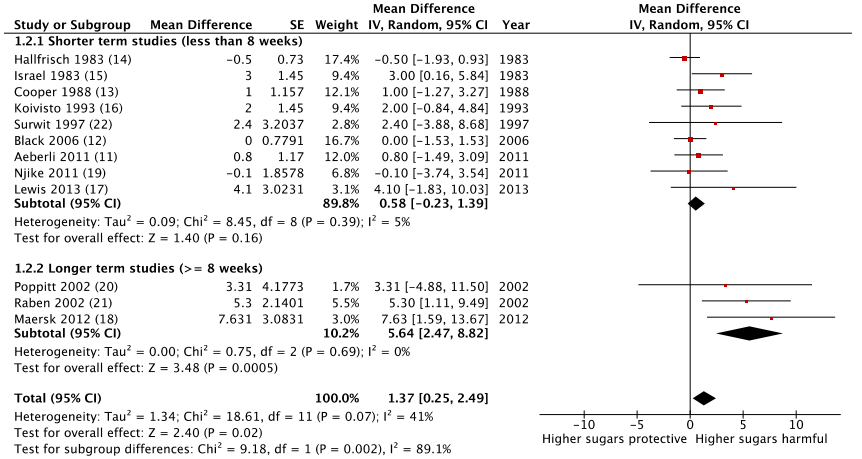
Lisa A Te Morenga, Alex J Howatson, Rhiannon M Jones, and Jim Mann




Study or Subgroup
Mean Difference
SE
Weight
Mean Difference IV, Random, 95% CI
Year
Mean Difference IV, Random, 95% CI
3.1.1 Isocaloric energy intake recommendation
Hallfrisch 1983 (14) −3 1.141 13.2% −3.00 [−5.24, −0.76] 1983
Israel 1983 (15) 2 1.516 11.9% 2.00 [−0.97, 4.97] 1983
Cooper 1988 (13) −1 1.157 13.2% −1.00 [−3.27, 1.27] 1988
Koivisto 1993 (16) 10 7.23 2.0% 10.00 [−4.17, 24.17] 1993
Surwit 1997 (22) −1.72 4.053 4.9% −1.72 [−9.66, 6.22] 1997
Black 2006 (12) −3 4.3135 4.5% −3.00 [−11.45, 5.45] 2006
Njike 2011 (19) −1.9 2.4469 8.7% −1.90 [−6.70, 2.90] 2011
Lewis 2013 (17) 4.3 2.3319 9.1% 4.30 [−0.27, 8.87] 2013
Subtotal (95% CI) 67.5% −0.24 [−2.38, 1.90]
Heterogeneity: Tau² = 4.13; Chi² = 14.68, df = 7 (P = 0.04); I² = 52%
Test for overall effect: Z = 0.22 (P = 0.83)
3.1.2 Ad libitum energy intake recommendation
Raben 2002 (21) 6.9 2.3854 8.9% 6.90 [2.22, 11.58] 2002
Poppitt 2002 (20) 1.72 5.136 3.5% 1.72 [−8.35, 11.79] 2002
Aeberli 2011 (11) −0.82 1.2 13.0% −0.82 [−3.17, 1.53] 2011
Maersk 2012 (18) 8.625 3.0072 7.1% 8.63 [2.73, 14.52] 2012
Subtotal (95% CI) 32.5% 4.01 [−1.47, 9.50]
Heterogeneity: Tau² = 22.85; Chi² = 14.46, df = 3 (P = 0.002); I² = 79%
Test for overall effect: Z = 1.44 (P = 0.15)
Total (95% CI) 100.0% 1.09 [−1.04, 3.22]
Heterogeneity: Tau² = 7.65; Chi² = 33.15, df = 11 (P = 0.0005); I² = 67%
Test for overall effect: Z = 1.00 (P = 0.32)
Test for subgroup differences: Chi² = 2.01, df = 1 (P = 0.16), I² = 50.2%
−20 −10 0 10 20
Favors higher sugar
Favors lower sugar


Study or Subgroup
Mean Difference
SE
Weight
Mean Difference IV, Random, 95% CI
Year
Mean Difference IV, Random, 95% CI
3.2.1 Isocaloric energy intake recommendation
Israel 1983 (15) 3 1.45 9.4% 3.00 [0.16, 5.84] 1983
Hallfrisch 1983 (14) −0.5 0.73 17.4% −0.50 [−1.93, 0.93] 1983
Cooper 1988 (13) 1 1.157 12.1% 1.00 [−1.27, 3.27] 1988
Koivisto 1993 (16) 2 1.45 9.4% 2.00 [−0.84, 4.84] 1993
Surwit 1997 (22) 2.4 3.2037 2.8% 2.40 [−3.88, 8.68] 1997
Black 2006 (12) 0 0.7791 16.7% 0.00 [−1.53, 1.53] 2006
Njike 2011 (19) −0.1 1.8578 6.8% −0.10 [−3.74, 3.54] 2011
Lewis 2013 (17) 4.1 3.0231 3.1% 4.10 [−1.83, 10.03] 2013
Subtotal (95% CI) 77.8% 0.65 [−0.31, 1.61]
Heterogeneity: Tau² = 0.31; Chi² = 8.39, df = 7 (P = 0.30); I² = 17%
Test for overall effect: Z = 1.33 (P = 0.18)
3.2.2 Ad libitum energy intake recommendation
Raben 2002 (21) 5.3 2.1401 5.5% 5.30 [1.11, 9.49] 2002
Poppitt 2002 (20) 3.31 4.1773 1.7% 3.31 [−4.88, 11.50] 2002
Aeberli 2011 (11) 0.8 1.17 12.0% 0.80 [−1.49, 3.09] 2011
Maersk 2012 (18) 7.631 3.0831 3.0% 7.63 [1.59, 13.67] 2012
Subtotal (95% CI) 22.2% 3.70 [0.28, 7.13]
Heterogeneity: Tau² = 6.31; Chi² = 6.63, df = 3 (P = 0.08); I² = 55%
Test for overall effect: Z = 2.12 (P = 0.03)
Total (95% CI) 100.0% 1.37 [0.25, 2.49]
Heterogeneity: Tau² = 1.34; Chi² = 18.61, df = 11 (P = 0.07); I² = 41%
Test for overall effect: Z = 2.40 (P = 0.02)
Test for subgroup differences: Chi² = 2.83, df = 1 (P = 0.09), I² = 64.6%
−10 −5 0 5 10
Favors higher sugar
Favors lower sugar


Study or Subgroup
Mean Difference
SE
Weight
Mean Difference
IV, Random, 95% CI
Year
Mean Difference
IV, Random, 95% CI
1.1.1 Shorter term studies (less than 8 weeks)
Israel 1983 (15) 2 1.516 11.9% 2.00 [-0.97, 4.97] 1983
Hallfrisch 1983 (14) -3 1.141 13.2% -3.00 [-5.24, -0.76] 1983
Cooper 1988 (13) -1 1.157 13.2% -1.00 [-3.27, 1.27] 1988
Koivisto 1993 (16) 10 7.23 2.0% 10.00 [-4.17, 24.17] 1993
Surwit 1997 (22) -1.72 4.053 4.9% -1.72 [-9.66, 6.22] 1997
Black 2006 (12) -3 4.3135 4.5% -3.00 [-11.45, 5.45] 2006
Njike 2011 (19) -1.9 2.4469 8.7% -1.90 [-6.70, 2.90] 2011
Aeberli 2011 (11) -0.82 1.2 13.0% -0.82 [-3.17, 1.53] 2011
Lewis 2013 (17) 4.3 2.3319 9.1% 4.30 [-0.27, 8.87] 2013
Subtotal (95% CI) 80.5% -0.42 [-2.13, 1.30]
Heterogeneity: Tau² = 2.64; Chi² = 14.68, df = 8 (P = 0.07); I² = 46%
Test for overall effect: Z = 0.48 (P = 0.63)
1.1.2 Longer term studies (>= 8 weeks)
Raben 2002 (21) 6.9 2.3854 8.9% 6.90 [2.22, 11.58] 2002
Poppitt 2002 (20) 1.72 5.136 3.5% 1.72 [-8.35, 11.79] 2002
Maersk 2012 (18) 8.625 3.0072 7.1% 8.63 [2.73, 14.52] 2012
Subtotal (95% CI) 19.5% 6.88 [3.44, 10.32]
Heterogeneity: Tau² = 0.00; Chi² = 1.35, df = 2 (P = 0.51); I² = 0%
Test for overall effect: Z = 3.92 (P < 0.0001)
Total (95% CI) 100.0% 1.09 [-1.04, 3.22]
Heterogeneity: Tau² = 7.65; Chi² = 33.15, df = 11 (P = 0.0005); I² = 67%
Test for overall effect: Z = 1.00 (P = 0.32)
Test for subgroup differences: Chi² = 13.84, df = 1 (P = 0.0002), I² = 92.8%
-20
-10
0
10
20
Higher sugars protective
Higher sugars harmful


Study or Subgroup
Mean Difference
SE
Weight
Mean Difference
IV, Random, 95% CI
Year
Mean Difference
IV, Random, 95% CI
1.2.1 Shorter term studies (less than 8 weeks)
Hallfrisch 1983 (14) -0.5 0.73 17.4% -0.50 [-1.93, 0.93] 1983
Israel 1983 (15) 3 1.45 9.4% 3.00 [0.16, 5.84] 1983
Cooper 1988 (13) 1 1.157 12.1% 1.00 [-1.27, 3.27] 1988
Koivisto 1993 (16) 2 1.45 9.4% 2.00 [-0.84, 4.84] 1993
Surwit 1997 (22) 2.4 3.2037 2.8% 2.40 [-3.88, 8.68] 1997
Black 2006 (12) 0 0.7791 16.7% 0.00 [-1.53, 1.53] 2006
Aeberli 2011 (11) 0.8 1.17 12.0% 0.80 [-1.49, 3.09] 2011
Njike 2011 (19) -0.1 1.8578 6.8% -0.10 [-3.74, 3.54] 2011
Lewis 2013 (17) 4.1 3.0231 3.1% 4.10 [-1.83, 10.03] 2013
Subtotal (95% CI) 89.8% 0.58 [-0.23, 1.39]
Heterogeneity: Tau² = 0.09; Chi² = 8.45, df = 8 (P = 0.39); I² = 5%
Test for overall effect: Z = 1.40 (P = 0.16)
1.2.2 Longer term studies (>= 8 weeks)
Poppitt 2002 (20) 3.31 4.1773 1.7% 3.31 [-4.88, 11.50] 2002
Raben 2002 (21) 5.3 2.1401 5.5% 5.30 [1.11, 9.49] 2002
Maersk 2012 (18) 7.631 3.0831 3.0% 7.63 [1.59, 13.67] 2012
Subtotal (95% CI) 10.2% 5.64 [2.47, 8.82]
Heterogeneity: Tau² = 0.00; Chi² = 0.75, df = 2 (P = 0.69); I² = 0%
Test for overall effect: Z = 3.48 (P = 0.0005)
Total (95% CI) 100.0% 1.37 [0.25, 2.49]
Heterogeneity: Tau² = 1.34; Chi² = 18.61, df = 11 (P = 0.07); I² = 41%
Test for overall effect: Z = 2.40 (P = 0.02)
Test for subgroup differences: Chi² = 9.18, df = 1 (P = 0.002), I² = 89.1%
-10
-5
0
5
10
Higher sugars protective
Higher sugars harmful

J Hypertens. 2014 Jul;32(7):1388-94; discussion 1394. doi: 10.1097/HJH.0000000000000182.

What is the feasibility of implementing effective sodium reduction strategies to treat hypertension in primary care settings? A systematic review.

Ruzicka M[1], Hiremath S, Steiner S, Helis E, Szczotka A, Baker P, Fodor G.

Author information

Abstract

OBJECTIVE: To evaluate whether efficacious counseling methods on sodium restriction can be successfully incorporated into primary care models for the management of hypertension.

METHODS: We searched MEDLINE, Embase, Cochrane Central Register of Controlled Trials, Database of Abstracts of Reviews of Effects and Health Technology Assessment to identify randomized controlled trials of dietary counseling for salt intake reduction that reported significant reduction in 24-h urinary sodium and blood pressure levels among adults with untreated hypertension. Data extraction and assessment of reproducibility and feasibility were done in duplicate and any disagreements were resolved by consensus.

RESULTS: Six trials were included for assessment of methods as they were efficacious in reducing sodium intake (24-h urinary sodium excretion) by 73 to 93 mmol/day (intervention) vs. 3.2 to 12.5 mmol/day (control). This was paralleled with a reduction in blood pressure (-4 to -27 mmHg) between groups. In four of the six trials, the methods were described in sufficient detail to be reproducible, but in none of these trials were the 'counseling methods' feasible for application in primary care settings. Apart from multiple sessions of counseling, the reported interventions were supplemented with provision of prepared food, community cooking classes, and intensive inpatient training sessions.

CONCLUSION: Despite the availability of efficacious counseling methods for the reduction of sodium intake among newly diagnosed hypertensive patients (feasible within a clinical trial setting), none of these methods, in their present form, are suitable for incorporation into existing primary care settings in countries such as Canada, United States, and UK.

PERSONALIZED MEDICINE?


genomic
care
health
tools
informed
personalized
information
medicine
decision
clinical
disease
risk
making
metabolites
complex
approach
assessment
genome
proteins
genomes
include
scientific
enable
require
among
embrace
development
important
individual
guide
dramatic
addition
risks
policies
consumers
officials
support
selection
however
informs
clinic
behind
unidoubtedly
begins
precise
key
revolution
practice
decade
certainty
evidence
effective
prognosis
bursement
sequence
steady
form
person's
leadership
Although
dose
DNA-based
prediction
public
comprehensive
continuum
integration
legislative
already
regulatory
shift
fast-moving
person
management
application
whole
field
way
interrogation
medical
fundamentals
ples
along
protections
full
reim
confronted
treatment
last
area
use
transcription
formation
standardization
RNA
cancer
just
system-wide
molecular
ge
senior
nome-guided
component
spawning
technological
rapidly
identify
perspective
privacy
family
exam
history
government
well
industry
alized
predictive
findings
providers
Together
workflows
ing
challenges
environmental
derivatives
systems
solved
therapy
paradigm
diagnosis
signatures
enabled
patient
variation
Genomic
witnessed
adoption
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Thus
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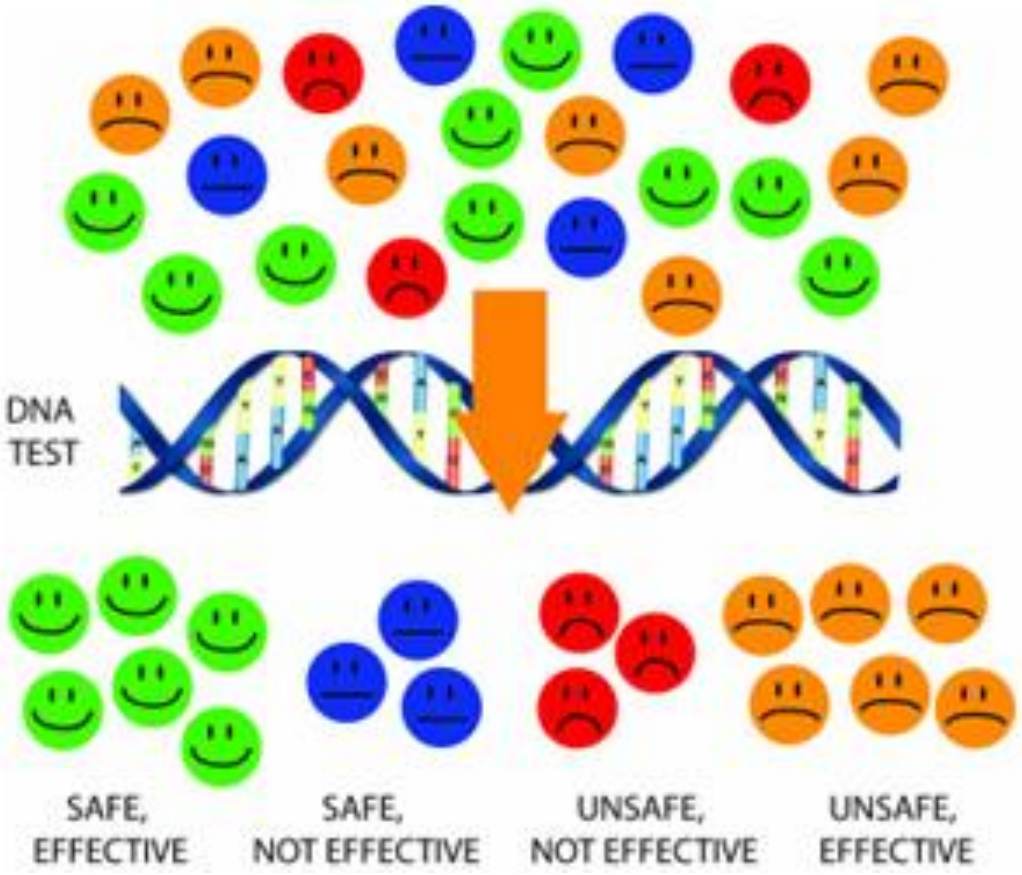
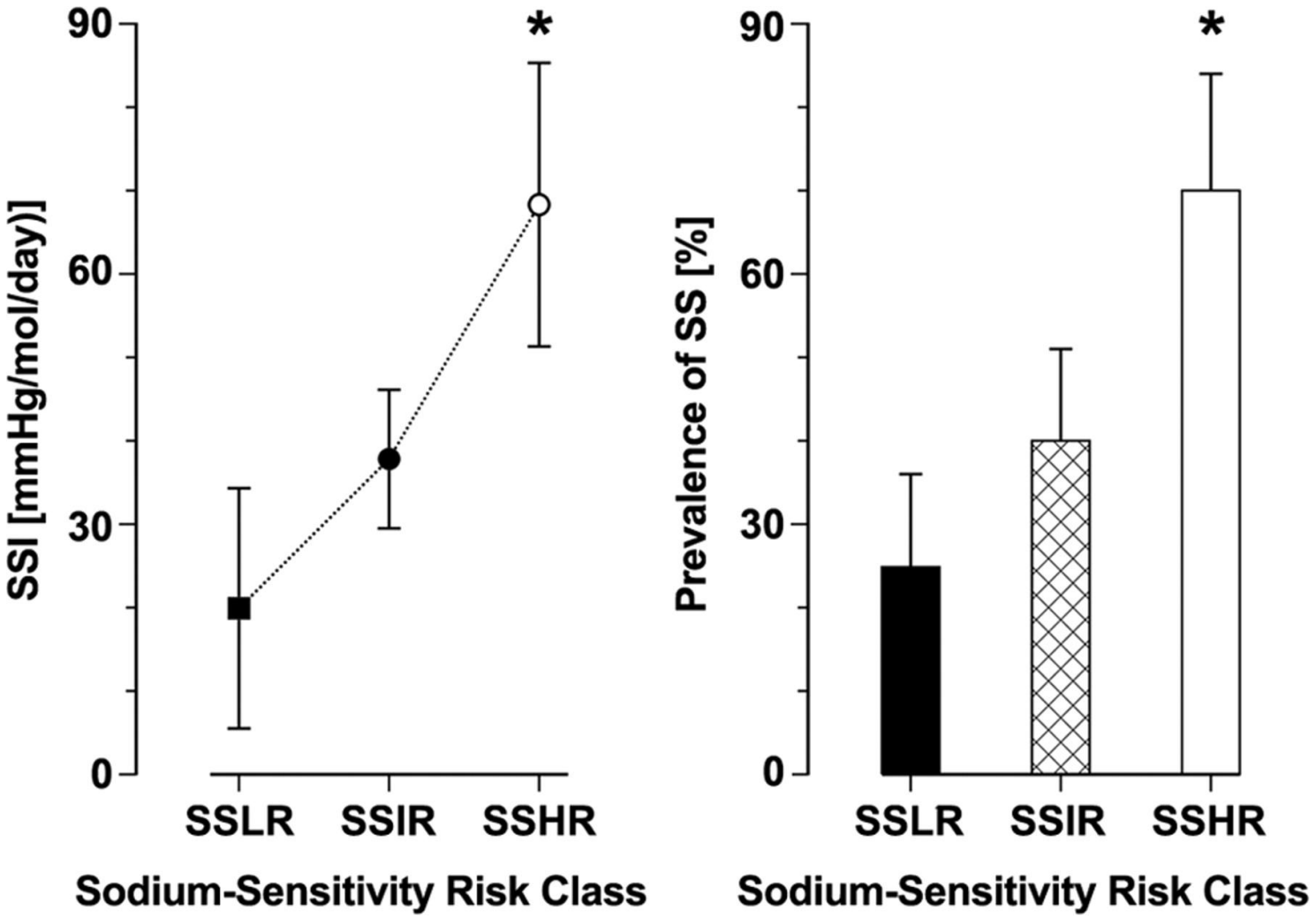
advanc
science
common
affect
social
based
unique
genetic
policy

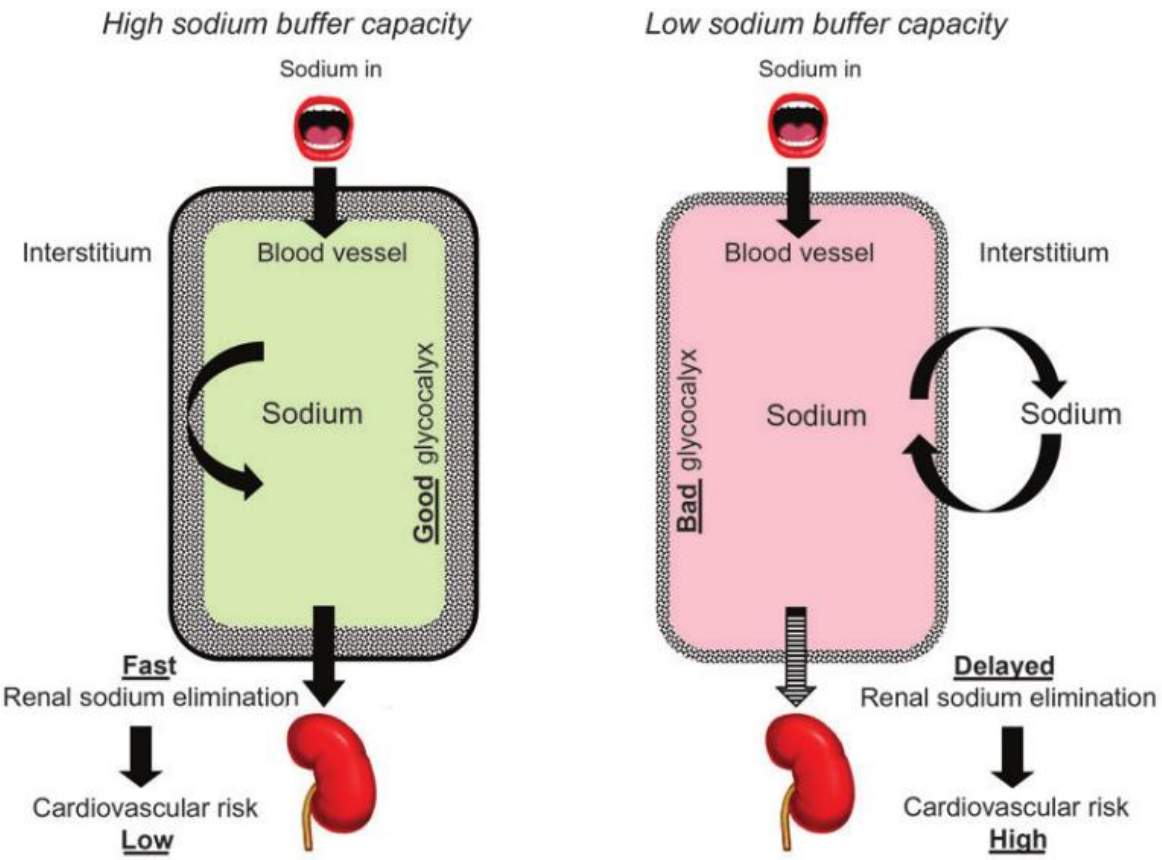

DNA
TEST
SAFE,
EFFECTIVE
SAFE,
NOT EFFECTIVE
UNSAFE,
NOT EFFECTIVE
UNSAFE,
EFFECTIVE

Sodium sensitivity in the groups of patients classified as SSLR, intermediate sodium sensitivity risk (SSIR), and SSHR based on MAPNF and HR24H values.



Paolo Castiglioni et al. Hypertension. 2011;57:180-185

Vascular endothelium: a vulnerable transit zone for merciless sodium



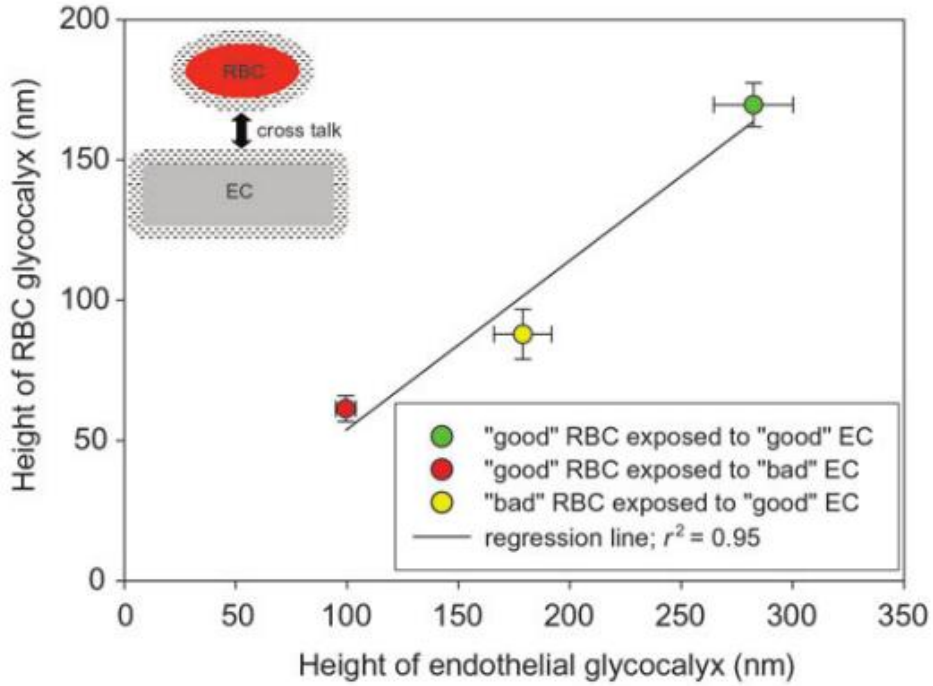


FIGURE 4: Correlation between red blood cell (RBC) glycocalyx and endothelial glycocalyx. The strong correlation indicates direct cross-talk between blood and vessel surface (modified after [55]).

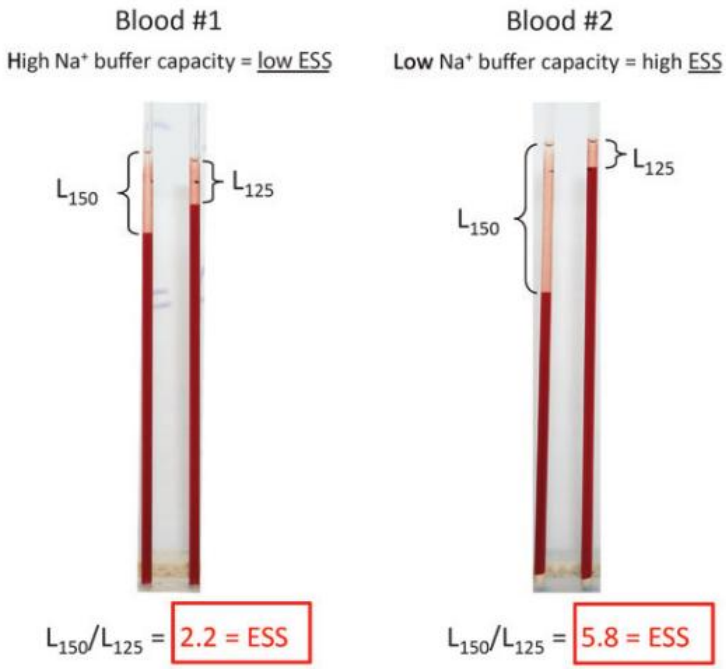


FIGURE 5: Erythrocyte sodium sensitivity measurements (ESS) indicating 'weak' erythrocyte Na^+ sensitivity (blood #1) and 'strong' erythrocyte Na^+ sensitivity (blood #2) (modified after [68]).

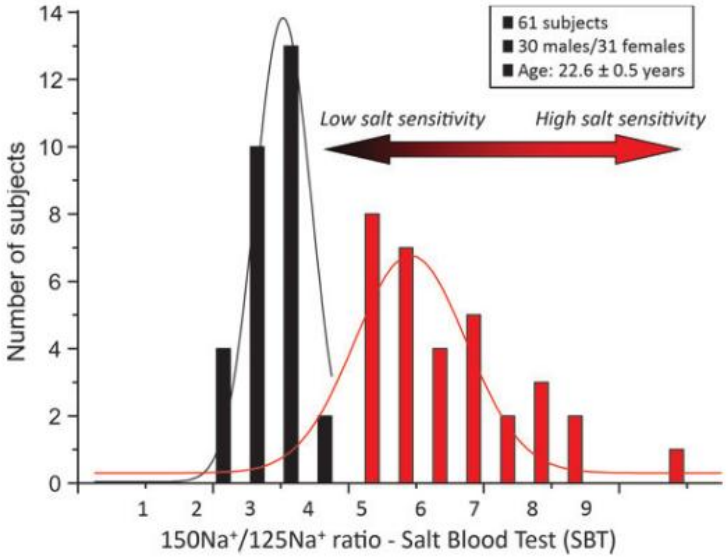


FIGURE 6: Frequency distribution of the erythrocyte sodium sensitivity (ESS) in a cohort of 61 study participants (modified after [68]).

סיכום

Curr Hypertens Rep. 2013 Dec;15(6):687-93. doi: 10.1007/s11906-013-0389-5.

An update on the salt wars-genuine controversy, poor science, or vested interest?

Neal B[1], Land MA, Woodward M.

Author information

The salt debate - far more salacious than salubrious

Satin M[1].

Author information

Abstract

The scientific evidence supporting dietary sodium reduction as a means of improving overall health outcomes is not yet confirmed and continues to generate considerable controversy. As previously with fat reduction, sodium reduction has become the dominant research subject in the global food industry. To comply with perceived public opinion, the largest multinational food companies have made public commitments to major reductions in sodium to meet current recommendations. This is the precise approach taken when fat came under criticism by public health agencies in the past and many believe that this precipitated our current obesity epidemic. The contradiction between the published scientific evidence on overall health outcomes and the aggressive promotion of sodium reduction policies by health authorities has inspired the characterization of this strategy as, '… the largest delusion in the history of preventative medicine' and others have concluded '… the concealment of scientific uncertainty in this case has been a mistake that has served neither the ends of science nor good policy'. While policy makers may occasionally be forced to act in the face of limited evidence to attempt to limit risks at the population level, this exception cannot be taken as a broad license to deny all new evidence that contradicts a planned agenda, if policies are to be the product of evidence rather than dogma. As was the case with fat, the strategy of sodium reduction may well qualify as a 'Trojan Horse' of preventative medicine - a policy with an outward façade of great value but simultaneously concealing a significant risk to the population.

salubrious adjective

בָּרִיא, יפה לבריאות

salacious adjective

תַּאֲוָתָנִי, בַּעַל תַּאֲוָה, עַגְבָנִי; אֲרוֹטִי, גַּס

- … However, no large-scale randomized trials have been conducted to determine the effect of low sodium intake on CV events.
- Prospective cohort studies evaluating the association between sodium intake and CV outcomes have been inconsistent and a number of recent studies have reported an association between low sodium intake (in the range recommended by current guidelines) and an increased risk of CV death.
- In the largest of these studies, a J-shaped association between sodium intake and CV death and heart failure was found.

- Despite a large body of research in this area, there are divergent interpretations of these data, with some advocating a re-evaluation of the current guideline recommendations.
- Similar to other areas in prevention, the controversy is likely to remain unresolved until large-scale definitive randomized controlled trials are conducted to determine the effect of low sodium intake (compared to moderate intake) on CVD incidence.