

Hypertension

The great salt debate: too much or too little?



Too much salt is undoubtedly bad for you, but too little may also not be good, according to new research. **Prof Eoin O'Brien** of the UCD Conway Institute of Biomolecular and Biomedical Research examines the latest evidence in the controversy

The word ‘controversy’ should be dispelled from scientific reasoning and replaced with ‘scientific uncertainty’, but regrettably the subject of dietary salt can stir polemic rhetoric that can be very unscientific.

When apparent dogma is challenged, a dispassionate examination of the evidence and the performance, where indicated, of controlled trials to resolve uncertainty is the reasoned (and most beneficial) course.

The scientific uncertainty with salt is that there is no argument about the fact that we consume too much of it and that this is harmful, but rather that in imposing a low salt intake on all, we may do harm to a significant number of people who need a moderate amount of salt.

Salt intake

We add too much salt to food and there is too much of it in most processed foods, which is a major source of dietary salt. The average daily salt intake in Ireland is high – approximately 10g per day in adults, and perhaps as high as 5–6g per day in children. Most national agencies recommend under 3g per day for adults.

There is no argument but that excessive salt in the diet raises blood pressure, which is a major cause of stroke, heart attack and kidney disease, and that reducing salt lowers blood pressure. It should follow, therefore, that policies to reduce salt intake in the community should be beneficial in preventing the cardiovascular consequences of elevated blood pressure.

Though there were muted opponents to a strategy of non-descript reduction of salt in the diet, there was general acceptance that governments should be persuaded that the lower the salt intake of the nation the better will be the health of all.

Doubts about universal salt restriction

The first serious challenge to such a policy came with publication of a paper in the *Journal of the American Medical Association (JAMA)* in May 2011 by Prof Jan Staessen and his colleagues in the University of Leuven in Belgium, in which the associations between blood pressure and sodium intake was not reflected in an improved outcome and in which, moreover, excessive reduction of salt seemed to be associated with higher cardiovascular mortality (*JAMA*, 2011 May 4;305(17):1777–85. doi: 10.1001/



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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)

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

jama.2011.574). The authors concluded that caution was needed before instigating recommendations for a generalised and indiscriminate reduction of salt intake. They were careful to emphasise that their results did not negate the blood pressure-lowering effects of dietary salt reduction in hypertensive patients.

The study was dismissed by *The Lancet* as contributing “little to our understanding of salt and disease” and that “the results of this work should neither change thinking nor practice” (*Lancet*, Vol 377, Issue 9778, doi:10.1016/S0140-6736(11)60657-0). The grounds for such stringent criticism were based mainly on the fact that important issues “cannot be answered by small observational studies” and that “it is dangerous to jump to conclusions on the basis of single studies and ignore the totality of evidence”.

Then, as often happens in science, the refutation to this intolerant dismissal of scientific

evidence came with another publication in *JAMA* in November 2011, from the Population Health Research Institute at McMaster University in Canada with a Galway based scientist, **Prof Martin O'Donnell**, as the lead author (*JAMA* 2011;306:2229–2238).

In this study of 30,000 patients, the association of salt with cardiovascular outcome confirmed that too much salt is associated with increased risk from cardiovascular disease, but in keeping with Staessen's earlier findings the study also showed that a low sodium intake was associated with increased risk.

Based on their findings the authors stressed the need to establish a safe range for sodium intake by performing randomised controlled trials.

The PURE Study

And so the matter rested, albeit with rumblings of discontent and suggestions for randomised control trials to decide matters. That was until two



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papers (with Prof O'Donnell once again leading authorship of some 28 world experts) published the results of the PURE study last month in the *New England Journal of Medicine*, arguably medicine's premier journal, presenting new evidence to cast further doubt on the wisdom of universal salt reduction (*N Engl J Med* 2014; 371:612–623, August 14, 2014, DOI: 10.1056/NEJMoa1311889 and 371:7, 677–679).

The editorial by Dr Suzanne Oparil in the same journal begins by reminding us that: “Hypertension is the most common modifiable risk factor for cardiovascular disease and death. Worldwide, it is estimated that more than one billion adults have hypertension, that this figure is projected to climb to 1.5 billion by the year 2025, and that hypertension accounts for more than nine million deaths annually.” We should be compelled, therefore, to examine carefully any interventions, such as salt restriction, that can reverse these apocalyptic statistics.

Oparil then goes on to point out that in 2013 the Centers for Disease Control and Prevention asked the Institute of Medicine (IOM) to convene an expert committee to evaluate the evidence for a relation between sodium and health outcomes.

The committee concluded that most evidence supports a positive relation between high sodium intake and risk of cardiovascular disease but that there was inconclusive evidence to show if a low sodium intake (<2.3 g per day or <1.5 g per day, as recommended in many dietary guidelines) was associated with an increased or reduced risk of cardiovascular disease in the general population.

However, the committee warned that there was limited evidence that low salt intake might indeed be associated with adverse health effects in some subgroups, such as patients with heart failure or other forms of cardiovascular disease, diabetes, or chronic kidney disease.

The PURE study, which draws evidence from more than 100,000 adults sampled in 17 countries, now supports the caveat from the IOM by casting serious doubt on the assumption in the current guidelines that there is no unsafe lower limit of sodium intake.

We might well ask what adverse effects can result when the renin-angiotensin-aldosterone system is activated if sodium intake falls below about 3g per day? Moreover, a very small proportion of the world-wide population consumes a low-sodium diet and sodium intake is not related to blood pressure in these persons, calling into question, therefore, the feasibility and usefulness of reducing dietary sodium as a population-based strategy for lowering blood pressure.

The PURE study also raises the possibility that potassium could play as important a role as sodium. There is evidence that subjects who increase potassium consumption and reduce sodium consumption are at reduced risk of death from cardiovascular disease and this finding could serve as a model for a definitive trial that might show that the alternative approach of a diet rich in potassium might achieve greater health benefits, including blood-pressure reduction, than aggressive sodium reduction alone.

Oparil concludes her editorial by stating that “these provocative findings beg for a randomized, controlled outcome trial to compare reduced sodium intake with usual diet” and that “in the absence of such a trial, the results argue against reduction of dietary sodium as an isolated public health recommendation”.

Conclusions

So what can we reasonably conclude from these interesting studies?

- ‘Moderate’ sodium intake (about 3–5g of sodium) is likely to be optimal for most, with those with hypertension targeting the lower end of that range.
- A proportion of the population (proportion depends on the country, but somewhere between 20–30 per cent of population) consume excessive salt.
- A targeted approach to salt restriction (i.e. for those with high sodium intake) would seem more logical than a population-wide approach, which assumes that everyone eats too much salt.
- Nothing changes for people with high blood pressure who should be encouraged to reduce their salt intake, and for those who do not have high blood pressure and whose salt intake is high the message should be for a reduction in dietary salt.
- For non-hypertensive people the findings support reducing high sodium intake to moderate levels.
- There is now considerable uncertainty about whether low sodium intake across the entire population results in net clinical benefit.
- There is good evidence that a healthy dietary pattern, rich in foods containing potassium (fruit and vegetables) with moderate sodium intake is beneficial.
- There is a need to collect high-quality evidence from randomised controlled clinical trials to determine both the risks and benefits of low-sodium/high potassium diets.

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