



# Salt, Stroke & Heart Disease

## 1. Stroke

A stroke occurs when part of the blood flow to the brain is cut off. This causes a break in the oxygen supply, causing cells to die. Stroke is the third most common cause of death in England and Wales (Wolfe, 1996), with an estimated 150,000 strokes and mini strokes each year (*Office of National Statistics, 2001*) and 67,000 deaths from strokes each year (BHF, 2005). This equates to 9% of male and 13% of female deaths (*BHF, 2005*).

Stroke has a greater disability impact than any other chronic disease. The outcomes of strokes are wide ranging, but sufferers can experience paralysis, speech impediment and memory problems which can be highly frustrating and difficult for both the individual and the family. Over 300,000 people are living with moderate to severe disabilities as a result of stroke (*Adamson et al, 2005*). The direct cost of stroke to the NHS is estimated to be £2.8 billion (*National Audit Office, 2005*).

High blood pressure is the single most important cause of stroke. Salt is the major factor that increases blood pressure and is thereby responsible for many of the strokes (*Nagata et al, 2004*). There is also increasing evidence that salt may have a direct effect on strokes, independent of and in addition to the effect it has on blood pressure. A modest reduction in salt would have a significant impact on reducing strokes.

### Who is at risk?

Older people, people with high blood pressure, diabetics and smokers are at increased risk of having a stroke.

### Evidence

Raised blood pressure (BP) is a major cause of cardiovascular disease (CVD), responsible for 62% of stroke and 49% of coronary heart disease. Importantly, the risk of CVD increases throughout the range of BP, starting at 115/75 mmHg (*Lewington et al, 2002*). From the blood pressure reduction seen in a meta-analysis (*He et al, 2002*), it was estimated that a reduction of 6 g/d in salt intake would reduce stroke by 24% and coronary heart disease (CHD) by 18%. This would prevent  $\approx$ 35,000 stroke and CHD deaths a year in the UK and  $\approx$ 2.5 million deaths worldwide (*He et al, 2003*). A study from Japan showed a close relationship between salt intake and stroke mortality within a single country (*Nagata et al, 2004*).

A recent meta-analysis (*Strazullo et al, 2009*) of 19 independent cohort samples from 13 studies, with 177,025 participants showed that a high salt intake is associated with significantly increased risk of stroke and total cardiovascular disease. A reduction in salt intake from 10g to 5g per day, would reduce stroke rate by 23% and overall cardiovascular disease by 17%. This would save 0.25million deaths from strokes and almost 3 million deaths from cardiovascular disease *each year*. These results support the role of a substantial reduction in population salt intake for the prevention of cardiovascular disease.

### Salt and Stroke

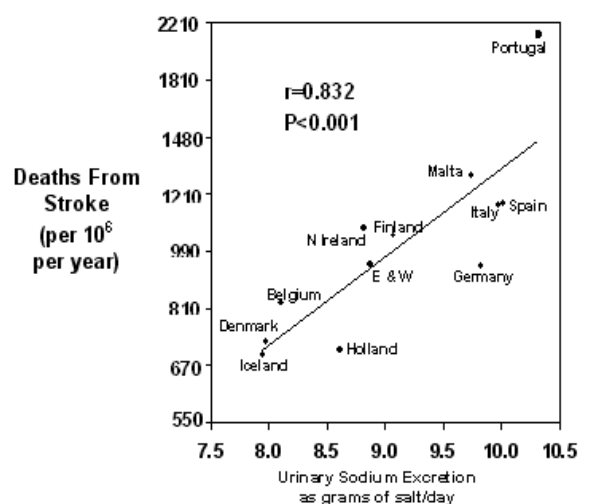


Figure 2. Relationship between salt intake as judged by 24h urinary salt excretion and stroke mortality in Western Europe. (Adapted from Perry, 1992)

## Direct effect on stroke

Evidence suggests that a high salt intake also has a direct effect on strokes, independent of the effect of salt on blood pressure (Perry & Beevers, 1992, Nagata, 2004, Xie et al, 1993). When different populations are compared, there is a very close correlation between salt intake and stroke mortality independent of blood pressure (Fig 2) (Perry et al, 1992). Another study has confirmed this with a single country (Nagata et al, 2004)

## 2. Heart Disease, Heart Attacks and Heart Failure

Raised blood pressure is a major risk factor for heart and circulatory disease including heart attacks and heart failure. Over time, untreated high blood pressure can lead to a thickening of the heart muscle which can reduce the effectiveness of the heart pumping action.

Raised BP is a major cause of cardiovascular disease (CVD), responsible for 62% of stroke and 49% of coronary heart disease. Importantly, the risk of CVD increases throughout the range of BP, starting at 115/75 mmHg (Lewington et al, 2002). It has been shown that a high salt intake, a low consumption of fruit and vegetables (i.e. low potassium intake), obesity, excess alcohol intake and lack of physical exercise all contribute to the development of high BP. However, the diversity and strength of the evidence is much greater for salt than for other factors.

### Direct effect on left ventricular mass

Salt intake can directly and independently lead to enlargement of the heart (Fig 1). Reducing salt intake has been shown to reduce left ventricular hypertrophy (Schmeider et al, 1988), which is a major risk factor for cardiovascular disease.

A number of cross-sectional studies have shown a positive correlation between 24-h urinary sodium and left ventricular mass (Kupari et al, 1994, Schmeider et al, 1988, du Calier et al, 1992). A reduction in salt intake has been shown to decrease left ventricular mass in hypertensive individuals (Ferrara 1984, Liebson 1995, Jula, 1994)

### Current Salt Intake & Dietary Advice

Almost everyone in the UK (and the rest of the Western world) eats too much salt. The daily recommended amount in the UK is no more than 6 grams a day, the current average salt intake is 8.6g salt a day although many people are eating more than this.

People with, or considered at risk, of stroke or heart disease should take extra care to ensure that they keep their salt intake below the recommended maximum of 6g. This can be achieved by simple changes, such as consuming less processed foods and checking product labels before purchase.

For more information and advice on how to reduce your salt intake, please visit our website [www.actiononhealth.org.uk](http://www.actiononhealth.org.uk)

### Salt and Left Ventricular Mass

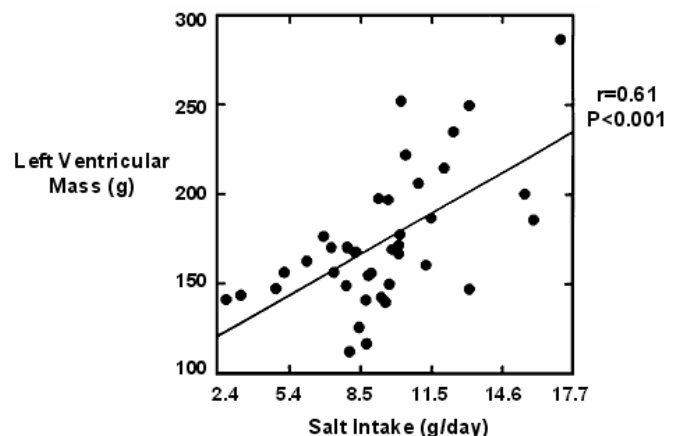


Figure 1. Relationship between salt intake and left ventricular mass in individuals with systolic blood pressure >121 mmHg. (Adapted from (Schmeider 1988).

## References

- Adamson, J, Beswick, A. and Ebrahim, S. Stroke and Disability Journal of Stroke and Cerebrovascular Diseases Vol 13, No. 4 2004.
- British Heart Foundation, 2005. Coronary Heart Disease Statistics.
- Du Cailar G, Ribstein J, Daures JP, et al: Sodium and left ventricular mass in untreated hypertensive and normotensive subjects. *Am J Physiol* 263:H177-181, 1992.
- He FJ, MacGregor GA. Effect of modest salt reduction on blood pressure: a meta-analysis of randomized trials. Implications for public health. *Journal of human hypertension*. 2002;16:761-770
- He FJ, MacGregor GA: How far should salt intake be reduced? *Hypertension* 42:1093-1099, 2003.
- Kupari M, Koskinen P, Virolainen J: Correlates of left ventricular mass in a population sample aged 36 to 37 years. Focus on lifestyle and salt intake. *Circulation* 89:1041-1050, 1994.
- Ferrara LA, de Simone G, Paganis F, et al: Left ventricular mass reduction during salt depletion in arterial hypertension. *Hypertension* 6:755-759, 1984.
- Jula AM, Karanko HM: Effects on left ventricular hypertrophy of long-term nonpharmacological treatment with sodium restriction in mild-to-moderate essential hypertension. *Circulation* 89:1023-1031, 1994.
- Levy D, Garrison RJ, Savage DD, et al: Prognostic implications of echocardiographically determined left ventricular mass in the Framingham Heart Study. *N Engl J Med* 322:1561-1566, 1990.
- Lewington S, Clarke R, Qizilbash N, et al: Age-specific relevance of usual blood pressure to vascular mortality: a meta-analysis of individual data for one million adults in 61 prospective studies. *Lancet*. 360:1903-1913, 2002.
- Liebson PR, Grandits GA, Dianzumba S, et al: Comparison of five antihypertensive monotherapies and placebo for change in left ventricular mass in patients receiving nutritional-hygienic therapy in the Treatment of Mild Hypertension Study (TOMHS). *Circulation* 91:698-706, 1995.
- Nagata C, Takatsuka N, Shimizu N, Shimizu H. Sodium intake and risk of death from stroke in Japanese men and women. *Stroke*. 2004;35:1543-7.
- National Audit Office, 2005. Brain Damage: Faster access to better stroke care.
- Office of National Statistics Health Statistics Quarterly (12) Winter 2001 "Stroke incidence and risk factors in a population based cohort study"; Scottish Stroke Care Audit 2005/2006.
- Perry IJ, Beevers DG: Salt intake and stroke: a possible direct effect. *J Hum Hypertens* 6:23-25, 1992.
- Schmieder R E, Messerli F H, Garavaglia G E, Nunez B D. Dietary salt intake. A determinant of cardiac involvement in essential hypertension. *Circulation*. 1988;78:951-6.
- Strazullo P, D'Elia L, Kandala N-B, Cappuccio FP. Salt intake, Stroke and Cardiovascular Disease: meta-analysis of prospective studies. *British Medical Journal*. 2009; 339:b4567doi:10.1136/bmj.b4567
- Stroke Association website, 2009 [4/9/09]
- Xie JX, Sasaki S, Joossens JV, et al: The relationship between urinary cations obtained from the INTERSALT study and cerebrovascular mortality. *J Hum Hypertens* 6:17-21, 1992.
- Wolfe, C " The Burden of Stroke" in Wolfe, C, Rudd, T and Beech, R (eds) *Stroke Services and Research* (1996) The Stroke Association

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