



Blood pressure is the most important cause of death and disability in the world

Feng J. He and Graham A. MacGregor*

Blood Pressure Unit, Cardiac and Vascular Sciences, St. George's University of London, Cranmer Terrace, London SW17 0RE, UK

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Raised blood pressure is the major cause of death in the world and the second major cause of disability next to childhood malnutrition. Furthermore, the risk of cardiovascular disease starts at as low as 115 mmHg of systolic or 75 mmHg of diastolic pressure, although the conventional cut-off point for hypertension is 140/90 mmHg. This means, in most countries of the world, more than 80% of adults are at risk from their blood pressure. Population strategies to lower blood pressure by gradually reducing salt intake, increasing potassium intake, reducing weight and increasing physical exercise, and at the same time, to obtain better control of raised blood pressure, where drugs are indicated, with more logical combinations of currently available drugs, will both lead to massive reduction in strokes, heart failure, and heart attacks.

Introduction

In the late 19th century, life assurance and mortgage companies were the first to realize that the higher the blood pressure, the greater are the chances of dying at an early age. Extensive epidemiological work and treatment trials have subsequently documented that the higher the blood pressure, the greater is the risk of dying from cardiovascular disease, i.e. stroke, heart attack, and heart failure.¹ Cardiovascular disease is the major cause of death and disability, both in the developing and the developed regions of the world. There are three major causes of cardiovascular disease: raised blood pressure, increased cholesterol, and cigarette smoking. Over 80% of cardiovascular disease is due to these three factors.² However, raised blood pressure is the single most important cause of death worldwide and the second major cause of disability next to childhood malnutrition³ (Figure 1).

Risks of raised blood pressure

In 2000, it was estimated that, 26.4% of the adult population had hypertension—defined as systolic pressure

≥ 140 mmHg or diastolic pressure ≥ 90 mmHg—and the total number of adults with hypertension was approximately 1 billion worldwide. This number was predicted to increase to a total of 1.56 billion in 2025.⁴ It is well documented that blood pressure gradually and progressively rises with increasing age so that the percentage of people with high blood pressure in any country varies with age, e.g. approximately 20% of 20-year olds, 40% of 40-year olds, 60% of 60-year olds, and 80% of 80-year olds.⁵ Furthermore, the risk of raised blood pressure does not start at the conventional cut-off point (i.e. 140/90 mmHg), but is throughout the range of blood pressure starting at a systolic blood pressure of 115 mmHg or a diastolic pressure of 75 mmHg as indicated by the epidemiological studies (Figure 2).¹ This means that for most countries of the world, more than 80% of all adults are at the risk from their blood pressure.⁵

Individuals in the top quintile of blood pressure have a 16-fold increase in risk of stroke when compared with those in the lowest quintile. However, those in the so-called 'high normal' or 'upper range of normal' blood pressure have a two- to four-fold increase in the risk of stroke. As the number of population with blood pressure in the upper range of normal is much greater than those with high blood pressure, the number of people dying

* Corresponding author. Tel: +44 020 8725 5774; fax: +44 020 8725 2959.
E-mail address: gmacgreg@sgul.ac.uk

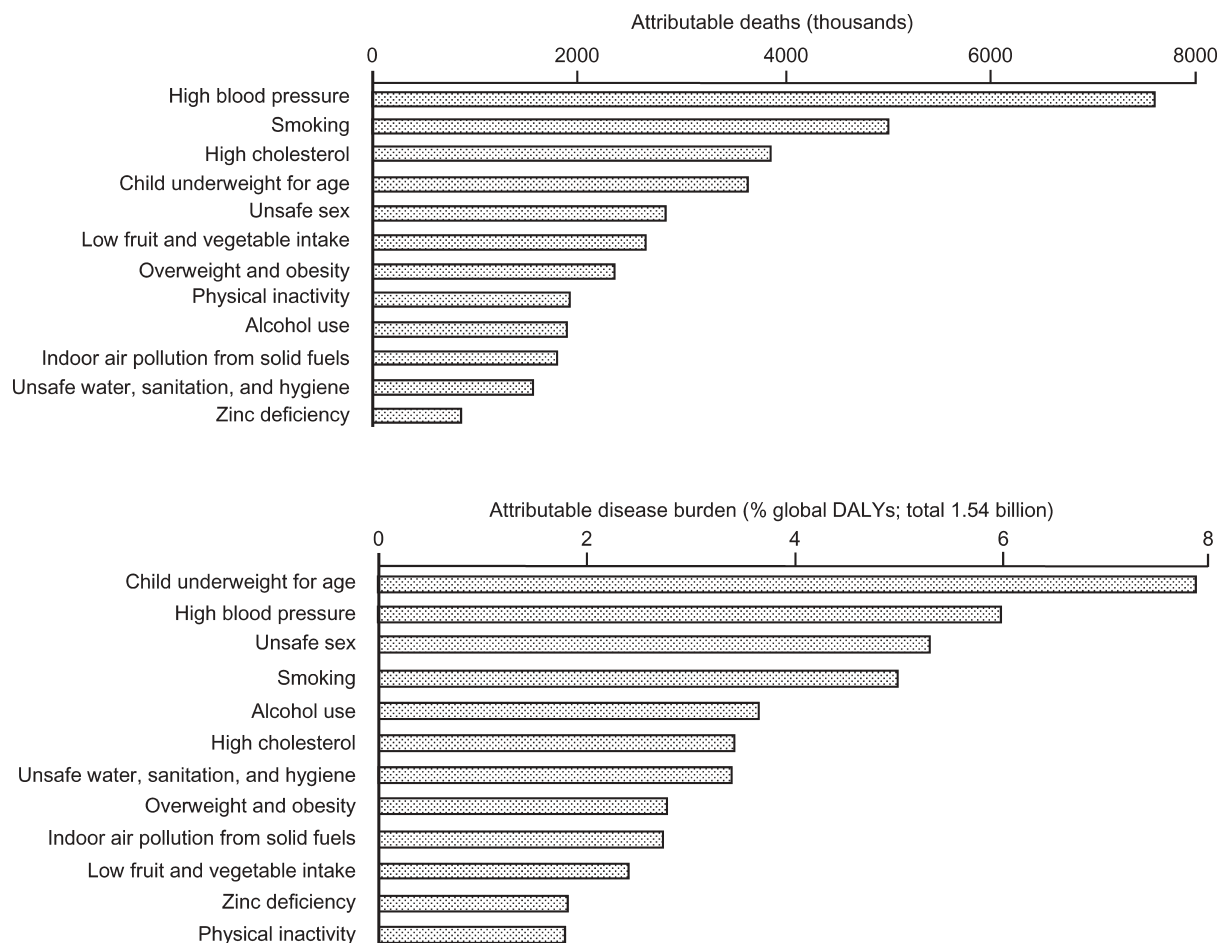


Figure 1 Deaths and disease burden due to leading global risk factors. Redrawn from Lopez *et al.*, *Lancet*, 2006.³

from raised blood pressure is greater in the so-called 'high normal' or 'upper range of normal' (Figure 3).⁶ This is because, although the risk for an individual is less, the numbers exposed are much greater than those for higher blood pressure.

The concept of average vs. 'normal'

Vivid illustration of the absurdity of calling average blood pressure as 'normal' is illustrated by the few tribes who still lead an evolutionary lifestyle. The Yamomamo Indians who are progressively dying in the Venezuelan/Brazilian Amazonian forests from infectious disease, still lead an evolutionary lifestyle as hunter gatherers living predominantly on fruits, vegetables, and roots, and occasionally on animals. They do not have access to salt, eat very little saturated fat, and have a high potassium intake through the fruit and vegetables they consume. The average blood pressure in an adult male Yamomamo Indian weighing 75 kg is 96/61 mmHg^{7,8} and the average cholesterol is 3.1 mmol/L. There is no rise in blood pressure or cholesterol with age and no evidence of vascular disease. Blood pressure in chimpanzees, gorillas, and orang-utans, when living

on their normal diet, are around the same levels, i.e. less than 110/70 mmHg. From this, we can re-define the normal blood pressure of humans, i.e. it should be less than 110/70 mmHg and anything above this should be regarded as abnormal, but this does not mean that the majority of the adult population should be on blood pressure-lowering drugs. Rather, we need from early infancy to adopt a dietary and lifestyle strategy that would prevent the insidious and gradual rise in blood pressure as we grow older.

Strategy

Given that cardiovascular disease is the most important cause of death and disability, it is vital that all countries in the world adopt a coherent and workable strategy.

- to seek out and treat those with hypertension, i.e. $\geq 140/90$ mmHg
- to reduce the blood pressure of the whole population and prevent the rise in blood pressure that occurs with age

Cardiovascular disease is almost entirely due to our diet and lifestyle and, while it is true that some individuals

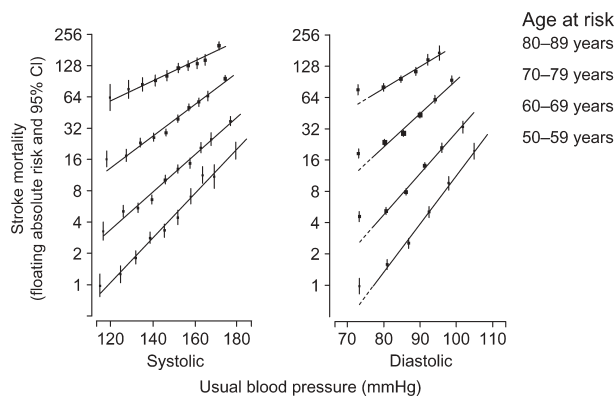


Figure 2 Relationship between blood pressure and stroke mortality by age group in a meta-analysis of individual data for one million adults in 61 prospective studies. From Lewington *et al.*, *Lancet*, 2002.¹

in a population may be more likely to develop cardiovascular disease for a given environment, we can, in fact, protect ourselves almost entirely whatever genes we inherit if we adopt the right lifestyle, by never smoking, eating very little saturated fat, and keeping our blood pressure within normal limits, i.e. less than 110/70 mmHg.

Risk factors for raised blood pressure

Factors that causes raised blood pressure in a population are well studied and well documented. They include

- high salt intake
- low potassium intake (low fruit and vegetable consumption)
- obesity
- lack of physical exercise
- excess alcohol

Salt

Evidence linking salt intake to raised blood pressure comes from six different types of studies:

- Epidemiological studies⁹
- Migration studies¹⁰
- Population-based intervention studies¹¹
- Genetic studies in man¹²
- Animal studies including chimpanzees¹³
- Treatment trials¹⁴

Epidemiological studies have demonstrated that salt intake is an important factor in determining the blood pressure level and the rise in blood pressure with age.⁹ Studies in migrant populations have shown an increase in blood pressure from a traditional rural to an urban environment where salt intake was increased along with other changes.¹⁰ An intervention study was done in two similar villages in Portugal. In one of these two villages, salt intake was successfully reduced by the provision of processed foods with less salt and appropriate dietary

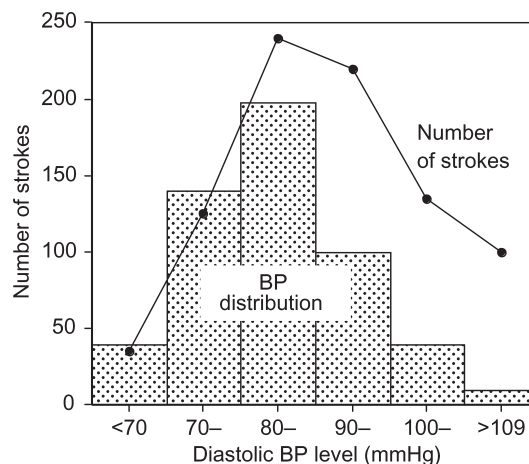


Figure 3 Absolute number of strokes in 405000 individuals in seven prospective observational studies by baseline diastolic blood pressure. Redrawn from MacMahon *et al.*, *J Hypertens*, 1996.⁶

advice, thus showing a large difference in blood pressure by the first year and a more pronounced difference in the second year.¹¹ Two other intervention studies, one in Belgium¹⁵ and one in North Karelia,¹⁶ did not achieve any reduction in salt intake, so unsurprisingly, there was no change in blood pressure. Evidence in animals, particularly in chimpanzees (98.8% genetic homology with man), provides strong support for a causal relationship between a high salt intake and a rise in blood pressure.¹³ Recently described rare mutations in humans, that may either cause high or low blood pressure, all involve a defect in the kidney's ability to excrete salt and are exacerbated by a high and low salt intake, respectively.¹²

Treatment trials have demonstrated that a modest reduction in salt intake, e.g. from our current intake of 10–12 g/day to the recommended level of 5–6 g/day caused significant fall in blood pressure both in hypertensive and normotensive individuals even though the trials were over a relatively short period of time, i.e. an average duration of 4–6 weeks.¹⁴ Furthermore, treatment trials have shown a dose–response relationship, the greater the reduction in salt intake, the greater the fall in blood pressure (*Figure 4*).¹⁷ The current public health recommendations to reduce salt intake from 10–12 g/day to 5–6 g/day will have a major effect on blood pressure, but are not ideal. A further reduction to 3 g/day will have a much greater effect and should, therefore, become the long-term target for population salt intake worldwide.

Fruit and vegetable consumption

Epidemiological, animal, and treatment trials have all shown that increasing potassium intake lowers blood pressure^{9,18,19} and that from an evolutionary point of view we were eating two to three times more potassium than we currently consume. Treatment trials have also demonstrated that doubling potassium intake lowers blood pressure and that this can most conveniently be

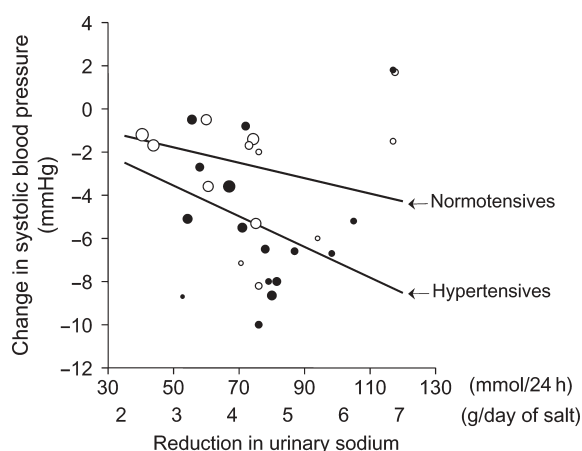


Figure 4 Relationship between the reduction in urinary sodium excretion and systolic blood pressure in a meta-analysis of modest salt reduction trials of 1 month or longer. The open circles represent normotensives and the solid circles represent hypertensives. The slope is weighted by the inverse of the variance of the net change in systolic blood pressure. The size of the circle is in proportion to the weight of the trial.

done by increasing fruit and vegetable consumption which may have other health benefits in addition to the potassium they contain that lowers blood pressure.^{20–22}

Body weight

Many studies have shown that there is a close relationship between body weight and blood pressure and that weight reduction trials, on the whole, have shown falls in blood pressure.²³ However, it is not clear to what extent weight reduction per se or the more healthy diet that is employed in these studies containing less salt and more fruit and vegetables, lowers blood pressure.

Alcohol

Epidemiological studies have shown a significant relationship between alcohol intake and blood pressure. However, studies of withdrawal of alcohol have shown that it is a fairly transient effect on blood pressure and alcohol does not seem to lead to sustained increase in blood pressure in the long-term.

Population strategy

Individual countries need to decide the best strategy for them to pursue. By far, the easiest strategy in terms of lowering blood pressure or preventing the rise in blood pressure with age is to reduce salt intake. In most developed countries the majority of salt, indeed 80% of salt, comes from salt already added by some sector of the food industry,²⁴ e.g. in processed, ready prepared meals, fast foods, canteen foods, restaurants etc., so that a reduction in salt intake in these countries can only be achieved by reducing the amount of salt added to food before the consumer buys it. However, in other

countries much of the salt eaten is added by the consumer either in the form of table or cooking salt or in the form of highly salty sauces, e.g. soya sauce. In these countries a different strategy needs to be adopted of encouraging consumers to use less salt although probably the best strategy is adoption of both of these policies as even in developing countries more and more food is being marketed by the food industry with salt already added.

Reducing salt intake

Finland has, for many years, had a policy of reducing the amount of salt added to foods. More recently, in the UK, a structured reduction in the salt added to food is being made. The strategy that had been adopted is to make 10–25% reduction in the salt concentration as these cannot be detected by the human salt taste receptors. These reductions can then be repeated at 1- or 2-yearly intervals so that the salt concentration of all foods where salt has been added can be reduced by half over a period of a few years. This policy needs to be applied throughout the food chain so that all foods that have had salt added are reduced in salt. It is vital that this policy also applies to foods marketed to young children as these are very high in salt, fat, and often sugar. These products are extremely cheap for the food industry to make and are profitable. The danger is that children get habituated to the very high salt concentrations in these foods, which makes it difficult to change to food with less salt.

At the same time, a public health campaign is needed pointing out the dangers of eating too much salt and encouraging reduction in the use of salt at home and sauces high in salt. Clear labelling of all foods with the salt, fat, sugar, and calorie content also needs to be carried out. By far, the clearest way of doing this is with the labelling system that has been developed in the UK, so-called 'Sign Post' labelling,²⁵ which is front of the pack labelling that clearly gives the amount per serving and has a colour code to indicate whether it is thought to be low, medium, or high in salt, fat, or sugar.

In those countries where the majority of salt is still added by the consumer either at the table or in the cooking or in the forms of sauces, a well thought out public health campaign making individuals aware of the dangers of consuming too much salt and using less at home, both at the table and in the cooking, should be carried out.

Increasing fruit and vegetable consumption

Increasing fruit and vegetable consumption through the higher potassium intake will lower blood pressure and this is an important strategy that should be adopted where practical.

Reducing body weight

All countries in the world are seeing an increase in obesity and diabetes. This is a difficult problem to deal

with given the reduction in physical activity and increasing consumption of calories, particularly with greater portion sizes, and increasingly calorie-dense foods, courtesy of the food industry. Populations should be encouraged to take more exercise, and also to eat less food, and particularly, less calorie-dense food.

Reducing other cardiovascular risk factors

While the measures discussed above will help to control blood pressure, it is vital that populations cease smoking cigarettes and reduce their saturated fat intake in order to lower cholesterol.

Strategy for hypertension (i.e. blood pressure $\geq 140/90$ mmHg)

Evidence from clinical trials

In individuals with high blood pressure, carefully conducted clinical trials over the last 40 years from all over the world have clearly demonstrated the immense benefits of lowering blood pressure with drugs when it is raised. Recent trials have demonstrated that quite modest reductions in blood pressure cause an average of 35–40% reduction in the risk of stroke and 20–25% reduction in the risk of coronary heart disease,²⁶ and a large fall in the number of people developing heart failure. However, in spite of this knowledge, many individuals with hypertension are neither detected, nor provided with an appropriate treatment. For most countries in the world, the number of people with high blood pressure who are controlled to target levels does not exceed 30%.²⁷ In other words, seven out of 10 or more individuals with raised blood pressure are not having their blood pressure adequately controlled. As a result, many unnecessary stroke and heart attack deaths happen. It is estimated that approximately 62 000 deaths from stroke and coronary heart disease would be prevented each year in the UK, if all hypertensive individuals had their systolic blood pressure controlled to the target level of 140 mmHg.²⁸

Treatment of high blood pressure

The major classes of drugs that are now used for treatment of hypertension are either angiotensin-converting enzyme-(ACE) inhibitors or angiotensin-receptor blockers (ARB), which block the effects of angiotensin II, calcium antagonists, or diuretics, particularly thiazide diuretics.

The current recommendations are that younger patients other than those who are black are started on an ACE or ARB and then have a calcium antagonist or diuretic added in or, alternatively, in older or black patients where individuals are started on a calcium antagonist or diuretic and then have an ACE or ARB added in (Figure 5).^{29,30} If individuals do not respond to these treatments, it is recommended to combine either an ACE or an ARB plus a calcium antagonist plus a

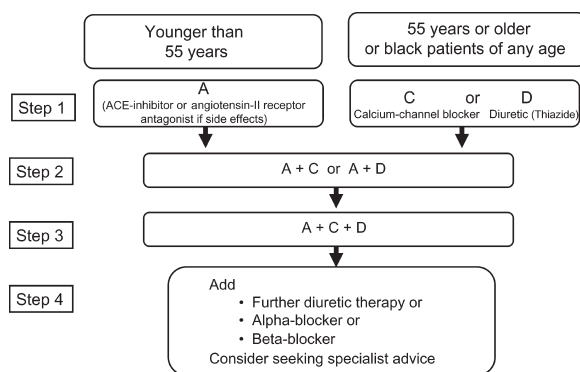


Figure 5 The clinical guideline on the management of hypertension by the National Institute for Health and Clinical Excellence (NICE) and the National Collaborating Centre for Chronic Conditions, in conjunction with the British Hypertension Society (BHS). Redrawn from the National Institute for Health and Clinical Excellence, 2006.²⁹

diuretic. This is a very effective way of ensuring good blood pressure control and would lead to more than 80% of the hypertensive population having their blood pressure controlled.

Therefore, much greater focus needs to be put on family doctors and other health professionals to get better control of blood pressure. At the same time individuals need to be more aware of the importance of controlling blood pressure.

Summary

Raised blood pressure is the major cause of death in the world, responsible for 60% of strokes and 50% of coronary heart disease. Strategies to reduce population blood pressure by gradually reducing salt intake and increasing potassium intake, and to obtain better control of raised blood pressure with logical combinations of currently available drugs will lead to a massive reduction in strokes, heart failure, and heart attacks. Worldwide this will result in considerable savings on health expenditure as, not only is raised blood pressure the biggest cause of death, but the second biggest cause of disability after childhood malnutrition.

Conflict of interest: none declared.

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