



Why 6g? A summary of the scientific evidence for the salt intake target

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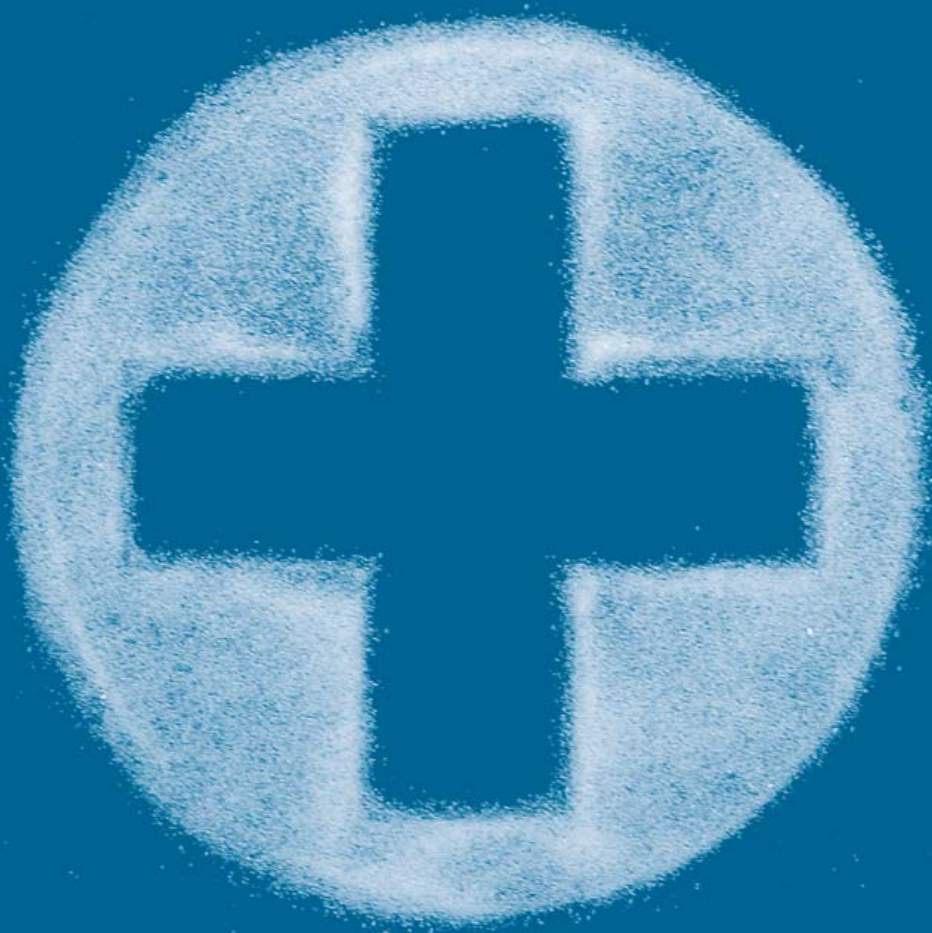


EXECUTIVE SUMMARY

This report summarises the scientific evidence on the links between salt and health that underpins the 6g a day salt intake target. It draws heavily on evidence reviewed by the UK Scientific Advisory Committee on Nutrition (SACN) 'Salt and Health' report (SACN 2003).

- A high dietary salt intake is associated with the development of high blood pressure which is linked to an increased risk of death from stroke and coronary heart disease.
 - Reductions in cardiovascular disease (CVD) are an important target for health improvement. Decreases in the average intake of salt will contribute to decreases in CVD.
 - In Great Britain, 32% of men and 30% of women have hypertension (a persistent raised blood pressure of 140/90 mmHg or above) or receive treatment for high blood pressure.
 - Controlled dietary intervention studies show that decreases in salt intake lead to reductions in blood pressure.
 - The effects of salt (sodium chloride) on blood pressure are linked to sodium. Sodium is also found in other forms in the diet, but more than 90% of sodium occurs as salt. Any recommendation for a reduction in sodium will, in practical terms, translate into a reduction in salt.
 - The Reference Nutrient Intake (RNI) for sodium, for young people over 11 years, and adults, is 1.6g, which is equivalent to approximately 4g salt per day.
 - The 2000/1 National Diet and Nutrition Survey showed the average salt intake is 9.5g per day, more than twice the RNI.
 - More than three-quarters of salt intake is derived from processed foods, approximately 15% from natural sources, about 10% added in cooking or at the table, and 1% from tap water.
 - A salt reduction target of 6g of salt a day, for adults, by 2010 was set by the Government as a challenging but achievable goal, which will bring measurable improvements in health. It does not represent an optimal or ideal level of consumption.
 - Further research is needed to assess the level of salt in children's diets, which may influence blood pressure independently of other factors. In the interim, it would be inadvisable for children in the UK to develop a preference for high salt intakes. Proportionally lower salt reduction targets have been set for children.
 - It has been estimated that a reduction in salt intake from current levels to the 6g per day target would predict a 13% reduction in stroke and a 10% reduction in coronary heart disease.
 - Clinical trials show that reductions in salt intake by consumers as a result of dietary advice alone are poorly sustained. Wider changes in the salt content of food are needed and action on the part of the food industry is an essential element.
- The salt reduction target is part of a broader strategy to reduce deaths from vascular disease. Evidence from clinical trials shows that greater reductions in blood pressure are observed when reductions in salt are accompanied by a diet low in total and saturated fat, with an increased consumption of fruit, vegetables and low-fat dairy foods. Achieving and maintaining a healthy weight and regular physical activity will also help to prevent and treat high blood pressure.

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BACKGROUND

Raised blood pressure (hypertension) is a major risk factor in the development of cardiovascular disease. In recent decades, a body of evidence has emerged from scientific research to suggest that a high dietary salt intake is an important causal factor in the development of hypertension.

Although the evidence for the association between high salt intakes and blood pressure relates to sodium, the major dietary source of sodium is salt (sodium chloride, NaCl). In 1994, the relationship between salt and blood pressure was noted by the Committee on Medical Aspects of Food and Nutrition Policy (COMA) as part of their report on 'Nutritional Aspects of Cardiovascular Disease' (DH 1994).

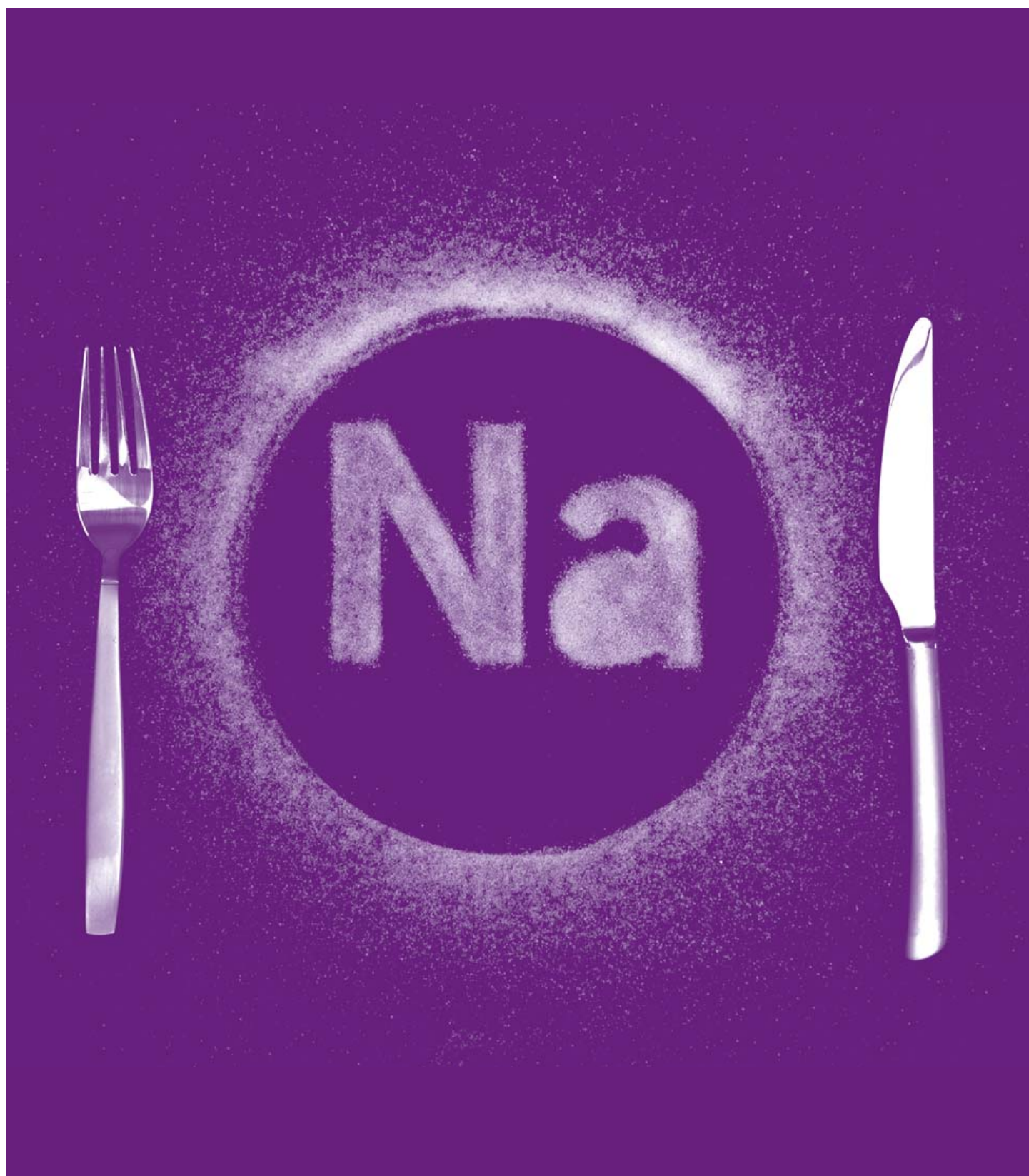
This was followed by a more detailed consideration by the UK Scientific Advisory Committee on Nutrition (SACN) in their report on 'Salt and Health' (SACN 2003). The SACN 'Salt and Health' report reviewed the scientific evidence, since 1994, on the relationship between salt and health. Simultaneously the World Health Organisation/Food and Agriculture Organisation report 'Diet, Nutrition and The Prevention of Chronic Diseases' (WHO/FAO 2003) concluded that there was convincing evidence that a high sodium intake increased the risk of developing cardiovascular disease.

Against the background of the evidence from these expert reports, the White Paper 'Choosing Health – Making Healthy Choices Easier' makes it clear that salt reduction is a priority for Government in the UK (DH 2004). The Food Standards Agency (FSA) is currently working with UK health departments and other stakeholders to reduce the average salt intake of adults to 6g per day by 2010. This forms one part of the strategy in the NHS Plan to reduce the death rate from coronary heart disease, stroke and related diseases in people under 75 years by at least 40% from 1995/7 to 2010 (DH 2000). This report, *Why 6g? A summary of the scientific evidence for the salt intake target* sets out the key evidence which underpins the recommendation for a reduction in salt intakes to a population average of 6g per day for children >11 years and adults by 2010, with proportionally lower targets for younger children.

Readers wishing to explore the evidence in more detail are encouraged to refer to the detailed SACN 'Salt and Health' report (SACN 2003).

“To reduce the death rate from coronary heart disease, stroke and related diseases in people under 75 years by at least 40% from 1995/7 to 2010.”

03



SALT OR SODIUM?

The association between salt and blood pressure relates specifically to sodium, however the major dietary source of sodium is sodium chloride i.e. salt.

This overview sets out some of the key evidence which underpins the salt reduction target. The terms salt and sodium are often used synonymously but on a weight basis, salt comprises 40% sodium and 60% chloride. To convert salt to sodium it is necessary to divide the salt figure by 2.5.

“Overwhelmingly, salt is the major source of sodium in the diet.”

In addition to salt (sodium chloride) there is a wide variety of other forms of sodium in our diet, many of which are used as additives in food processing, usually to add flavour, texture or as a preservative (Table 3.1). Thus total sodium intake is greater than that

estimated from salt alone. However, overwhelmingly, salt is the major source of sodium in the diet (approximately 90%) and therefore any recommendation for a reduction in sodium will, in practical terms, translate into a reduction in salt. Nonetheless it is important that reductions in salt intake are not accompanied by increases in other forms of sodium.

Sodium is an essential nutrient and an important component of the body water pool. There are complex physiological processes which regulate sodium concentration at the appropriate level, mostly by altering the amount of sodium excreted by the kidneys. However, over a prolonged period of time, a high dietary intake of sodium affects the ability of the kidneys to respond efficiently. Sodium excretion is impaired and this leads to an increase in blood pressure.

Table 3.1 Sources of sodium in foods.

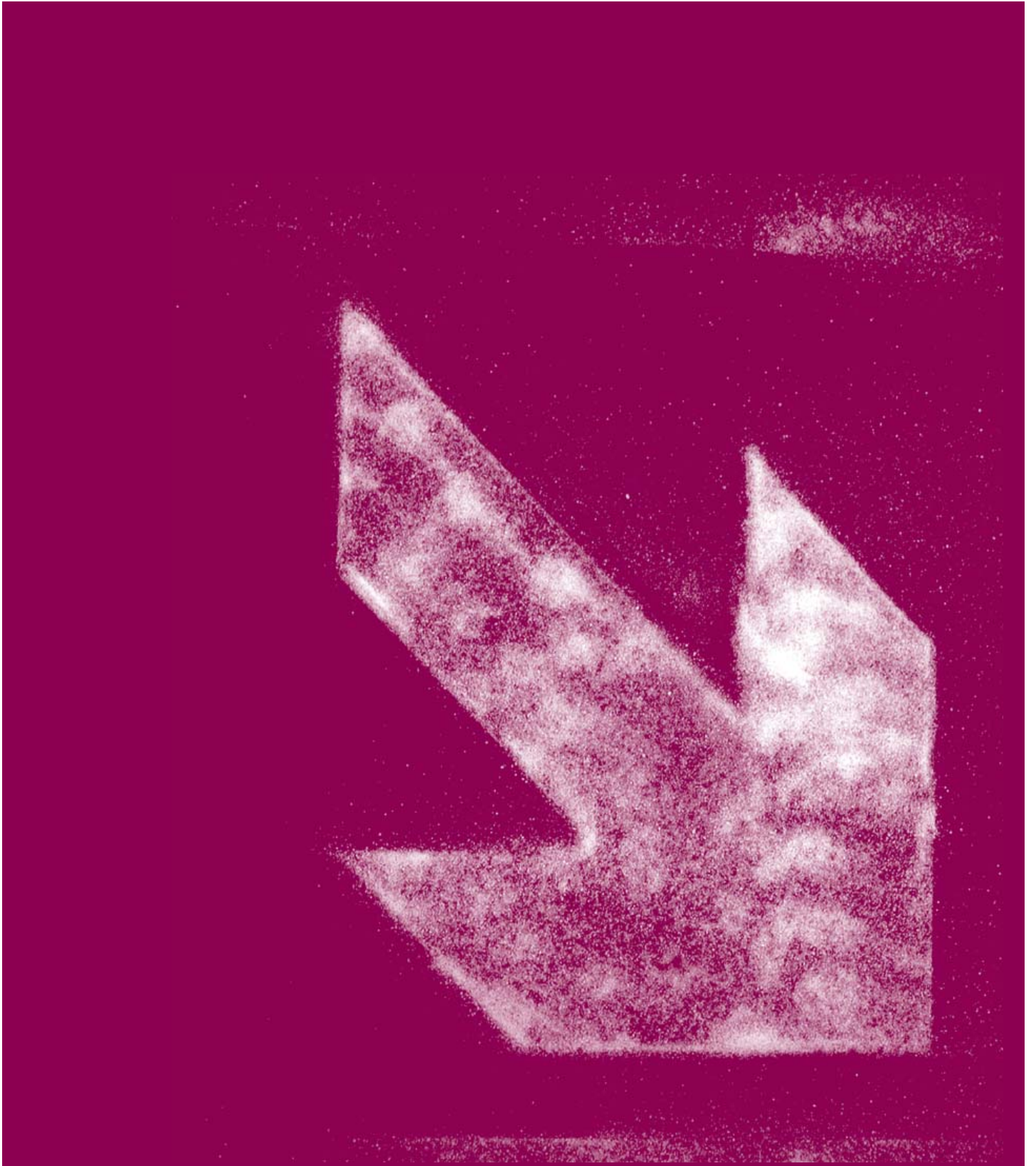
Additive	Use
Sodium citrate	Flavouring, preservative
Sodium chloride	Flavouring, texture, preservative
Monosodium glutamate	Flavour enhancer
Sodium cyclamate	Artificial sweetener
Sodium bicarbonate	Yeast substitute
Sodium nitrate	Preservative, colour fixative

Source: Gibney, Vorster and Kok 2002

Converting salt to sodium
1g salt = 0.4g sodium

Converting sodium to salt
1g sodium = 2.5g salt

04



BLOOD PRESSURE

High blood pressure is one of the most common disorders in the UK and is an important modifiable risk factor for coronary heart disease (the leading cause of premature death in the UK) and stroke (the third leading cause).

Blood pressure is the result of two opposing forces. Blood is pumped around the body by the left ventricle of the heart while the flow of blood is opposed by the resistance of the blood vessels. The pressure of blood flowing through the arteries varies at different times in the heart beat cycle. The peak, when the heart (left ventricle) contracts is known as the systolic pressure, and the minimum, when the heart relaxes, as diastolic pressure. Blood pressure is measured in terms of the height (millimetres) of a column of mercury (Hg) which it can support and is conventionally recorded as systolic pressure/diastolic pressure e.g. 120/80 millimetres of mercury (mmHg).

Blood pressure must be controlled within relatively narrow limits to ensure adequate blood flow to the tissues, but without placing excess demands on the heart. Optimal blood pressure is defined as systolic pressure <120mmHg and diastolic pressure <80mmHg.

High blood pressure (both systolic and diastolic) known as hypertension, is an important risk factor for cardiovascular disease (Table 4.1). Specific cut-offs are used for the clinical diagnosis of hypertension, but in practice the relationship between increasing blood pressure and risk of cardiovascular events is continuous. A meta-analysis of 61 prospective studies, including data for 1 million adults with no history of vascular disease at baseline showed a positive association between blood pressure and risk of death from vascular events, from a blood pressure of 115/75 mmHg and upwards (Lewington et al 2002). Figure 4.1 shows the relationship between systolic blood pressure and stroke mortality at different ages.

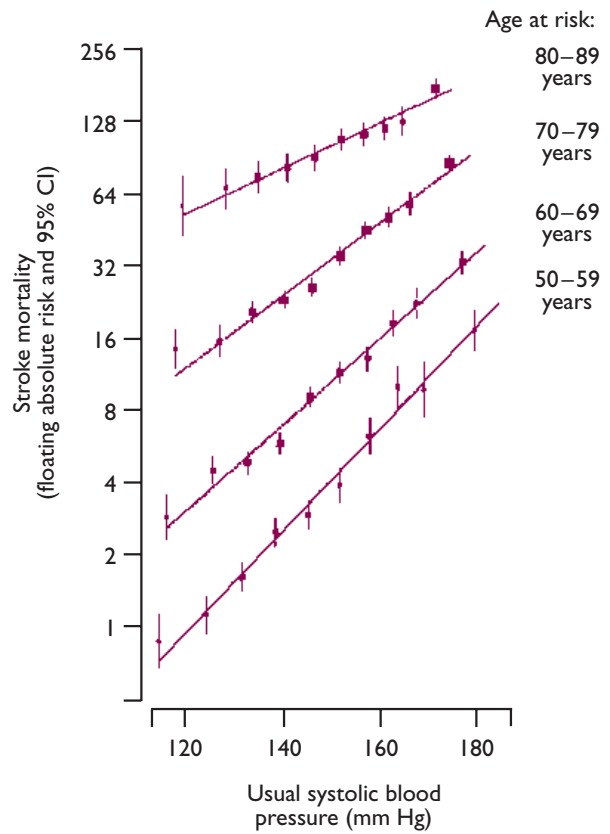
Table 4.1
Classification of blood pressure levels.

Category	Systolic BP (mmHg)	Diastolic BP (mmHg)
Optimal blood pressure	<120	<80
Normal blood pressure	<130	<85
High-normal blood pressure	130–139	85–89
Grade 1 hypertension (mild)	140–159	90–99
Grade 3 hypertension (severe)	≥180	≥110

“Lifestyle factors that contribute to hypertension include high salt intake, being overweight, physical inactivity and excess alcohol consumption.”

British Hypertension Society

Figure 4.1
Stroke mortality rate versus usual systolic blood pressure at the start of that decade: a meta-analysis of individual data for one million adults. (Reprinted with permission from Lewington et al 2002).



HYPERTENSION

There are two major clinical classifications of hypertension. Primary (essential) hypertension is of unknown cause and is responsible for at least 90% of all cases. A number of risk factors, including a high salt diet, increase the risk of primary hypertension. In secondary hypertension (approximately 10% of all cases), a recognised medical condition such as kidney disease, can be specifically diagnosed.

In England and Wales, the prevalence of hypertension (classified as blood pressure of 140/90 mmHg or above or receiving treatment for high blood pressure) is 32% for men and 30% for women (Blake et al 2004). The prevalence of hypertension increases with age in both sexes (Figure 4.2). In England, the increase in average systolic pressure between the ages of 16–24 years and 75 years and above is 18mmHg for men and 30mmHg for women (Blake et al 2003).

The World Health Organisation (WHO 2002) has estimated that the global burden attributable to a systolic blood pressure of 115mmHg or above is:

- 20% of all deaths in men and 24% of all deaths in women
- 62% of strokes and 49% of coronary heart disease
- 11% of disability adjusted life years (DALYs)

“32% of men and 30% of women aged 16 years or over have hypertension.”

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What is a DALY?

Daily Adjusted Life Years are a measure of the burden of disease and reflect the total amount of healthy life lost, to all causes, whether from premature mortality or from some degree of disability during a period of time.

Figure 4.2

Mean systolic blood pressure by age and sex in England.
(Data from Blake et al 2003).

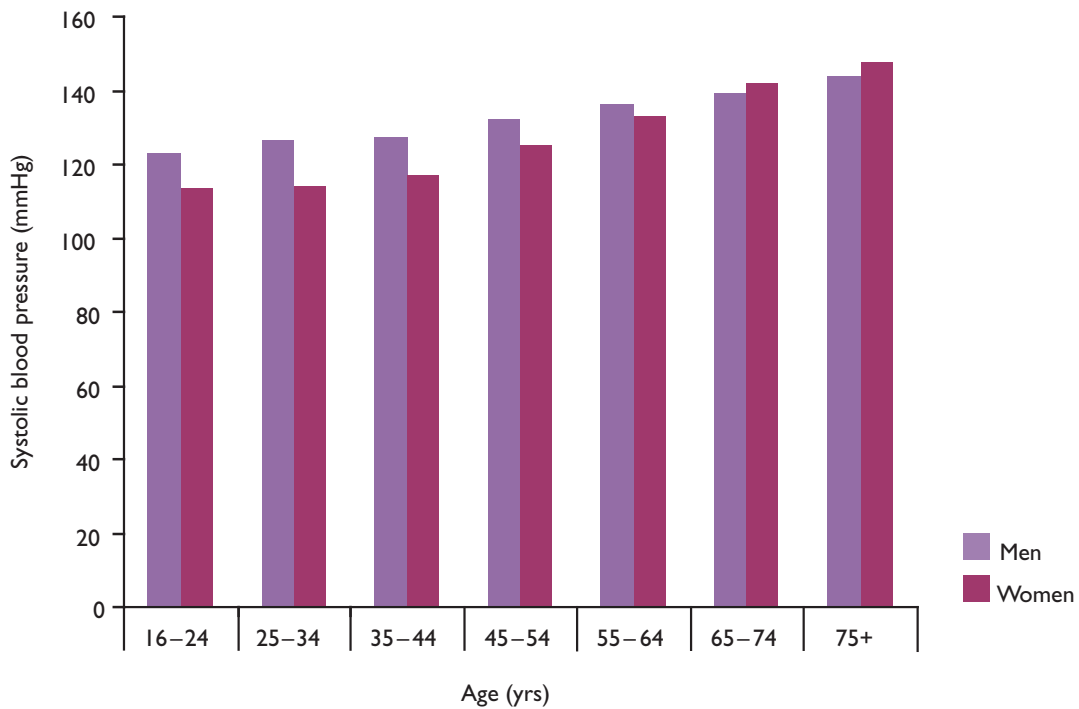


Table 4.2

Risk factors for developing hypertension.

Unmodifiable risk factors	Modifiable risk factors
Age and gender	Excess dietary salt
Ethnicity	Low dietary potassium
Family history	Overweight and obesity
	Physical inactivity
	Excess alcohol
	Smoking
	Cold homes
	Socioeconomic status
	Psychosocial stressors
	Diabetes
	Low birth weight
	Being formula fed as a baby

In the UK, the total cost (direct healthcare, informal care and lost productivity) of treating coronary heart disease is equivalent to about £7.06 billion and £5.77 billion for stroke (Liu et al 2002). It has been estimated that a reduction in current salt intakes to 6g/d would predict a 13% reduction in stroke and a 10% reduction in ischemic heart disease (He and MacGregor 2003).

The development of hypertension reflects a complex and dynamic interaction between genetic and environmental factors including lifestyle choices (Table 4.2). Differences in genetic susceptibility probably account for much of the blood pressure variation within a population, such as the UK, where everyone is exposed to a broadly similar environment. However differences in environmental factors largely determine variation in blood pressure levels between populations and within populations over time. Nonetheless genetic and environmental factors do not exist in isolation and there are likely to be important interactions (see Section 6).

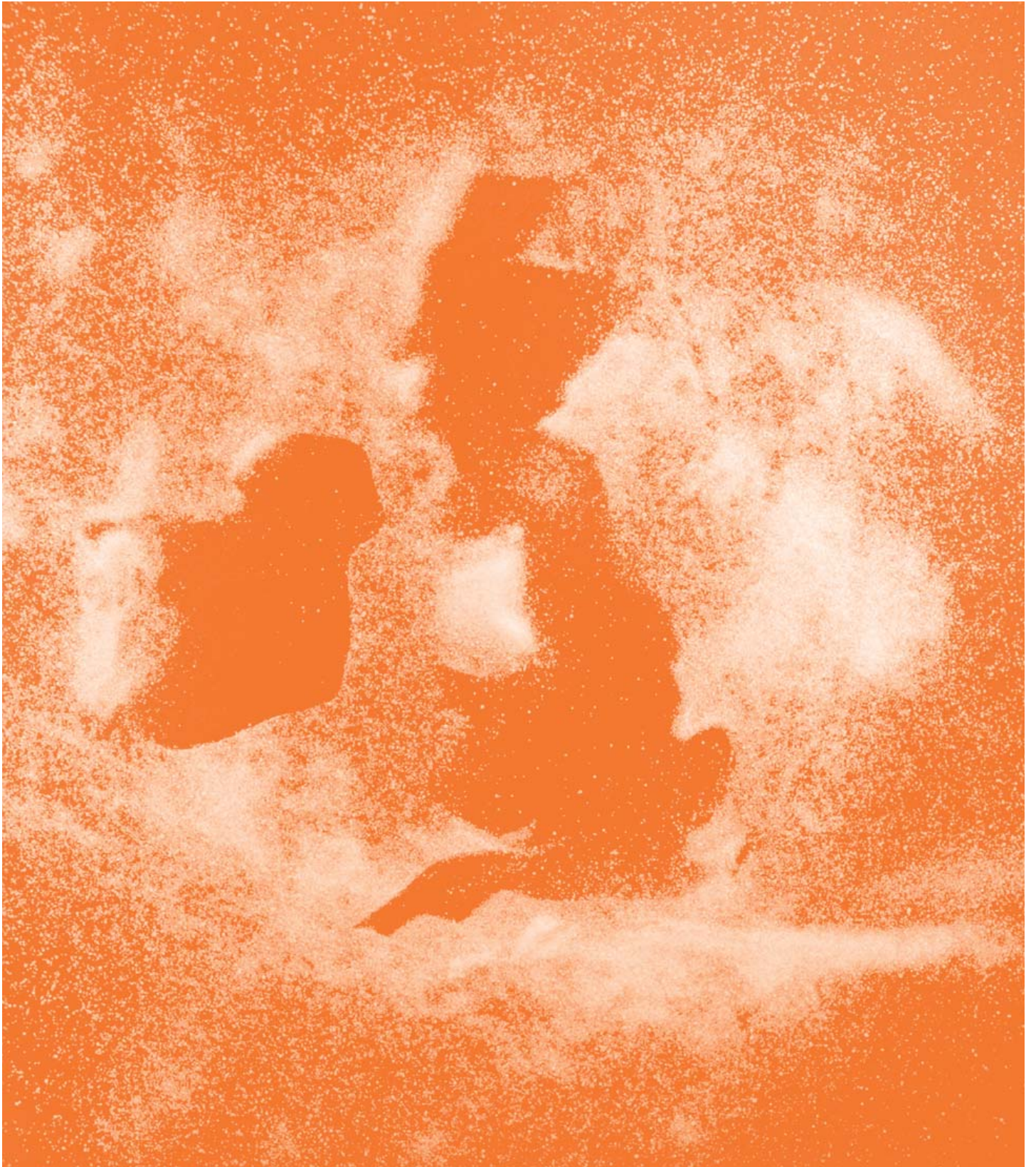
Other important lifestyle factors linked to increased risk of hypertension include physical inactivity, overweight, excess alcohol consumption and stress (Williams et al 2004). Many of these factors are interrelated and the relative contribution of each to the overall burden of hypertension cannot be precisely estimated.

Hypertension increases the risk of:

- Strain on the heart
- Heart muscle enlargement
- Inadequate blood supply to heart
- Poor oxygen supply to the heart
- Heart failure
- Angina
- Heart attack

“A reduction in current salt intake to 6g/d would predict a 13% reduction in stroke and a 10% reduction in ischemic heart disease.”

05



SALT INTAKE IN GREAT BRITAIN

Salt intake among adults (16–64 years) is more than 50% above the Reference Nutrient Intake (RNI). Only 15% occurs naturally in food and almost three-quarters of total salt intake comes from processed foods.

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Great Britain has a number of surveys that assess dietary intake and nutritional status of the population. Salt intake is difficult to measure using dietary assessment methods because of errors in reported intake, variability in the composition of foods, and the difficulty in determining the amount of salt added in cooking or at the table. More accurate estimates of salt intake can be obtained from measurements of 24-hour urinary sodium excretion. However this can also underestimate intakes if 24-hour urine collections are incomplete. There are also some minor losses of sodium via other routes e.g. skin, faeces etc. However 24-hour urinary sodium excretion is accepted as a useful measure of sodium intake. Although some other dietary components contribute to the sodium excreted in urine, salt is responsible for more than 90% of total urinary sodium.

The National Diet and Nutrition Survey of adults conducted in 2000/01 provides data for men and women aged 19–64 years. Using measures of 24-hour urinary sodium excretion, mean salt intake in 2000/01 was estimated to be 11.0g per day for men and 7.8g per day for women (Henderson et al 2003) (Figure 5.1). This represents nearly three times the Reference Nutrient Intake (RNI) for men (275%) and more than twice the RNI for women (202%). Only 15% of men and 31% of women consumed less than 6g per day of salt. The survey also shows that 21% of men and 5% of women consume more than 15g of salt per day. The average intake of salt for all adults has increased from 9g per day in 1986/87 (Gregory et al 1990) to 9.5g per day in 2000/01 (Henderson et al 2003), a small but notable increase (Figure 5.2).

“On average, salt intake is more than double the reference nutrient intake.”

“Only 15% of men and 31% of women consume less than 6g of salt per day.”

There is less detailed information available on salt intakes in free-living older people since 24-hour urinary sodium excretion was not measured in the National Diet and Nutrition Survey of older adults (≥ 65 years) conducted in 1994/95 (Finch et al 1998). The estimated intake of salt from food sources was 5.8g per day. This amount exceeds the RNI for adults by almost 50% (145%). Additionally, 73% of participants reported adding salt in cooking and 56% of participants added salt at the table (Finch et al 1998). In the survey of adults aged 19–64 years the estimated salt intake from 24-hour urinary sodium excretion was 25% higher than that estimated from food alone (Henderson et al 2003). If a similar situation exists for older people, salt intake can be estimated to be 7.2g per day.

a further 26% of the sodium in food (Henderson et al 2003).

In addition to dietary sources of sodium, salt is added during cooking and at the table. In adult surveys, three-quarters of adults report adding salt to their food during cooking and 61% of men and 51% of women added salt to food at the table either 'usually' or 'occasionally' (Henderson et al 2003). This is estimated to account for about 10% of total sodium intake. Approximately 1% of dietary sodium is derived from tap water. The sodium/salt content of some commonly consumed foods is shown in Figure 5.4.

“One in five men and one in twenty women consume more than 15g of salt per day.”

“Nearly three-quarters of the salt in our diet comes from processed foods.”

DIETARY SOURCES

The National Diet and Nutrition Survey provides an indication of the most important dietary sources of sodium in adults (of which salt is the major contributor). Nearly three-quarters of the sodium in the diet comes from processed foods (60–75%). Natural dietary sources provide a further 15%. Cereals, including breakfast cereals, bread, cakes, biscuits etc, are the largest contributors to sodium intake at 35%, of which white bread alone contributes 14% (Figure 5.3). Meat and meat products, like ham, provide

Figure 5.1
 Salt intake (estimated from 24-hour urinary sodium excretion) of 1146 adults in Great Britain (2000-1). (Data from Henderson et al 2003).
 Dashed line indicates salt reduction target of 6g per day.

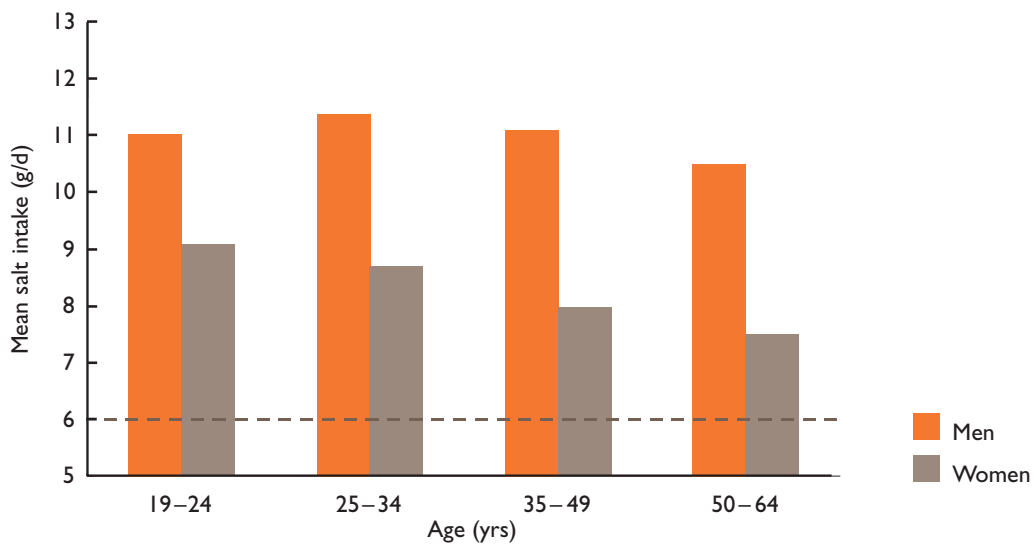
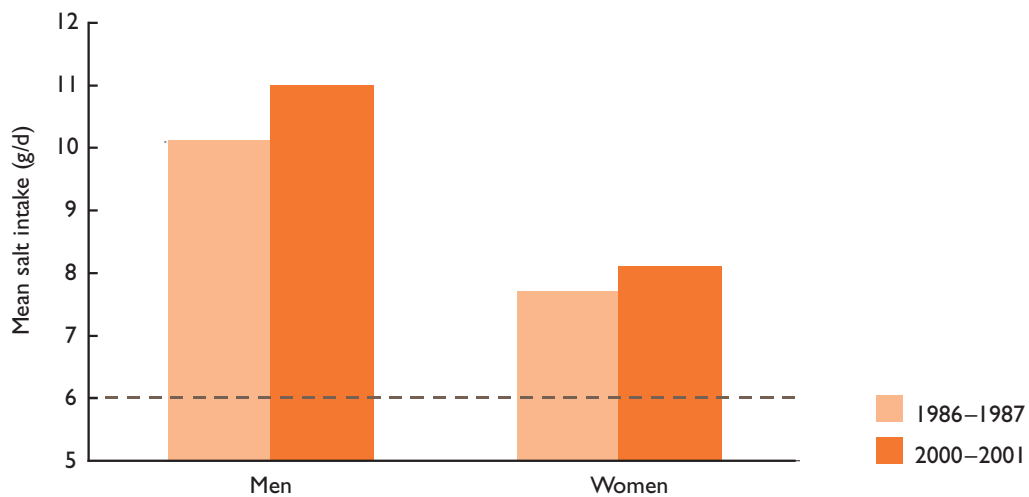


Figure 5.2
 Secular trends in salt intake (estimated from 24-hour urinary sodium excretion) of adults in Great Britain. (Data from Gregory et al 1990 and Henderson et al 2003).
 Dashed line indicates salt reduction target of 6g per day.



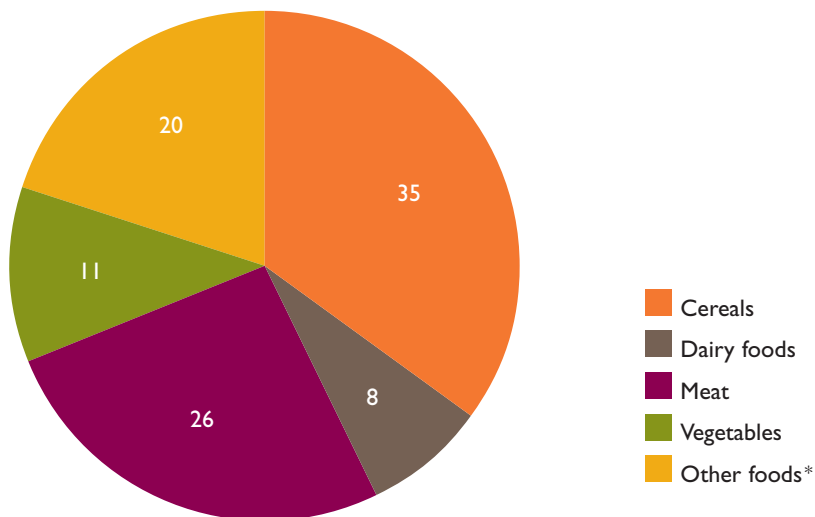
Reasons for using urinary sodium excretion as a measure of salt intake

- Dietary intake of sodium is difficult to assess
- Most sodium excreted in urine is derived from dietary salt
- Non-urinary losses of sodium are small

What is the Reference Nutrient Intake?

The RNI for a nutrient is the amount that meets the needs for more than 97% of the population. If the average intake of the population meets the RNI, then the risk of deficiency in the group is very small.

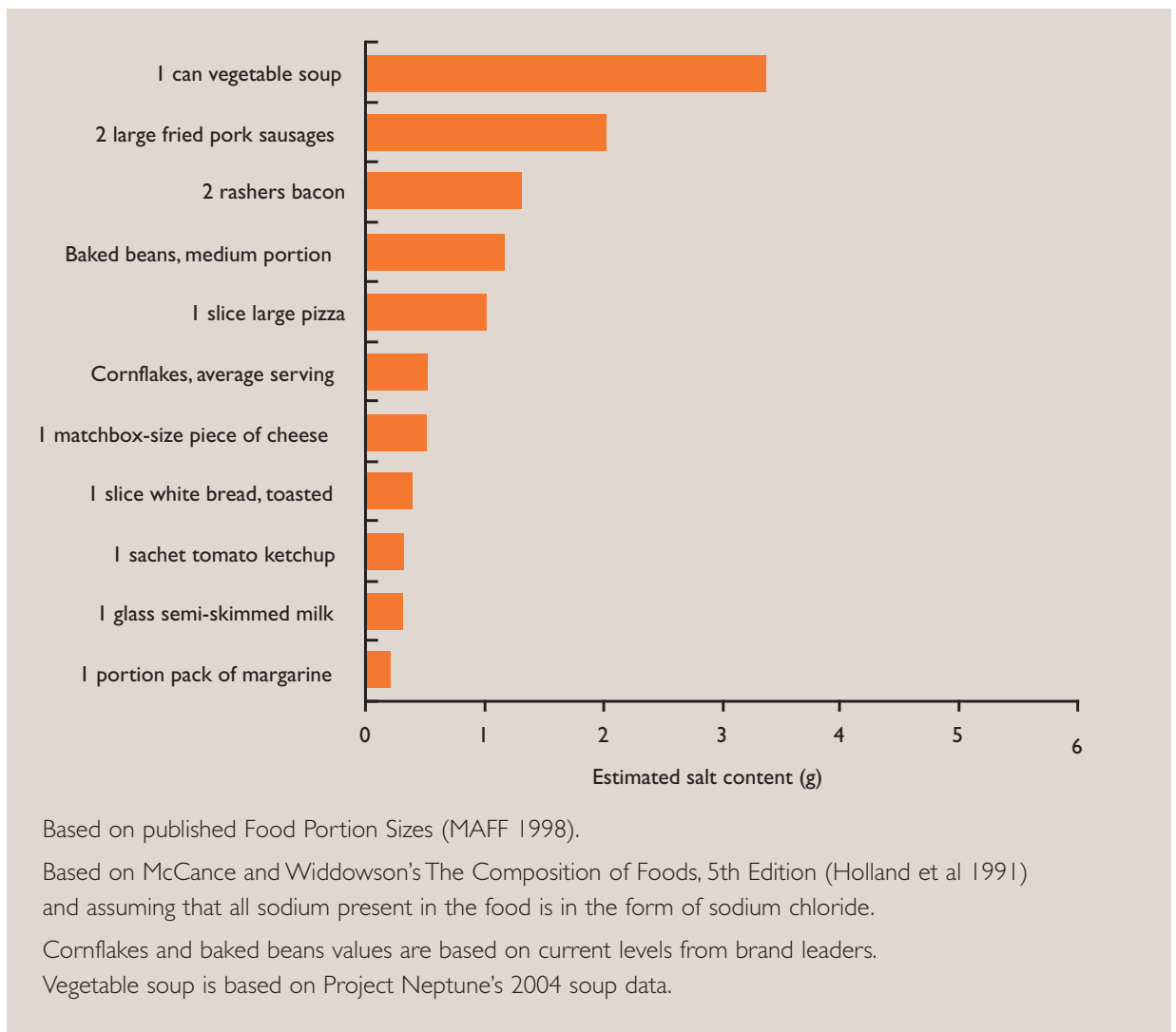
Figure 5.3
Food sources of sodium among adults.
(Data from Henderson et al 2003).



Values in pie sectors indicate percentage contribution. n=1724.

* Includes eggs and egg dishes, fat spreads, fish and fish dishes, sugar, preserves and confectionery, drinks and miscellaneous foods such as powdered drinks, soups and sauces.

Figure 5.4
Salt content of commonly consumed foods.



“The average adult intake of salt has increased from 9g a day in 1986/87 to 9.5g a day in 2000/01.”

06



SALT & HEALTH

A high salt intake has been associated with an adverse impact on long-term health especially hypertension. This evidence was reviewed in the SACN *'Salt and Health'* report (SACN 2003). Most evidence relates to the effects of salt on blood pressure and consequently on the risk of vascular disease. Reductions in salt intake can decrease blood pressure in adults of different ages and ethnic backgrounds. These improvements can be enhanced by other concomitant changes in diet and lifestyle.

BLOOD PRESSURE

The scientific evidence relating salt to high blood pressure is derived from a range of different types of studies including cross-sectional population studies and dietary intervention studies. It is also supported by research in animals. Together these studies suggest that (i) there is an association between dietary salt intake and blood pressure, (ii) reductions in dietary intake of salt can reduce blood pressure, especially in combination with broader dietary changes. However the maintenance of a reduced salt intake over time is poor and the reduction in blood pressure may not be maintained with dietary advice alone.

Many studies of the relationship between diet and health begin with cross-sectional observations of the differences in dietary habits between individuals or groups of people relative to their risk of ill-health. The evidence for an association between salt intake (based on 24-hour sodium excretion) and blood pressure is broadly consistent across groups of people of different ages and ethnicity.

The International Study of Salt and Blood Pressure, known as Intersalt, includes information on salt intake, (from 24-hour urinary sodium excretion) and blood pressure from more than 10,000 adults in 32 countries (Intersalt Co-operative Research Group 1988). Across populations, there was a positive association between urinary sodium excretion and systolic blood pressure. Within populations there was a significant positive association between salt intake and both systolic and diastolic blood pressure. However, 4 centres had particularly low intakes of salt and, when data from these centres were removed from the analysis the association between sodium and blood pressure was no longer significant.

“Reductions in dietary intake of salt can reduce blood pressure, especially in combination with broader dietary changes.”

“Increases in salt intake lead to increases in blood pressure.”

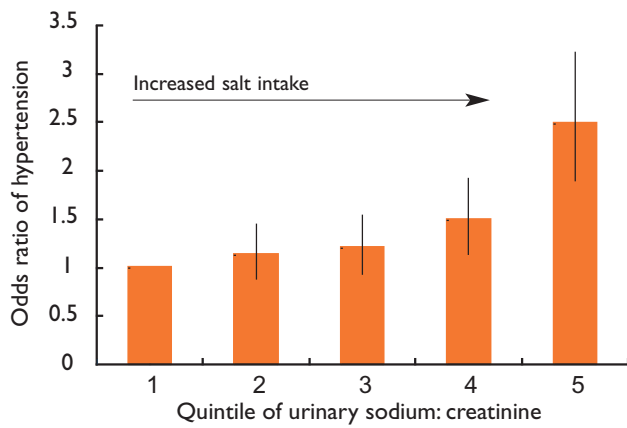
However, these ecological data do not address whether the effect of usual salt intake on blood pressure is of clinical or public health relevance. A recent analysis of data from 23,104 people aged 45-79 years, in Norfolk showed that, within a typical UK population, there was a significant trend between estimated salt intake and both systolic and diastolic blood pressure (Khaw et al 2004). For people with no history of hypertension, the risk of having high blood pressure was more than doubled for the 20% of people consuming the most salt (top quintile) relative to the 20% consuming the least salt (bottom quintile) (Figure 6.1a and 6.1b).

Cross-sectional studies cannot prove that a high salt intake causes raised blood pressure, independently of all other factors. Much stronger evidence can be obtained from intervention studies where the intake of salt is changed and the impact on blood pressure observed over a period of several weeks or more to allow time for the body to adapt to the altered intake of salt. Although a large number of studies have been carried out which have advised people to decrease salt, far fewer have rigorously supervised the dietary change with detailed checks on compliance and continued to do so over a long enough period for the body to adapt.

Evidence to show that an increase in salt intake leads to an increase in blood pressure comes from a study in a group of chimpanzees who were fed increasing amounts of salt for more than a year and a half (Denton et al 1995). Compared to animals fed their usual low salt diet, there was a 12 mmHg increase in systolic blood pressure after 19 weeks on a diet containing 5g/d salt and a 33 mmHg increase at the end of the study after 67 weeks on a diet containing 15g/d salt. Furthermore blood pressure returned to control values by 20 weeks after the end of the period of salt addition.

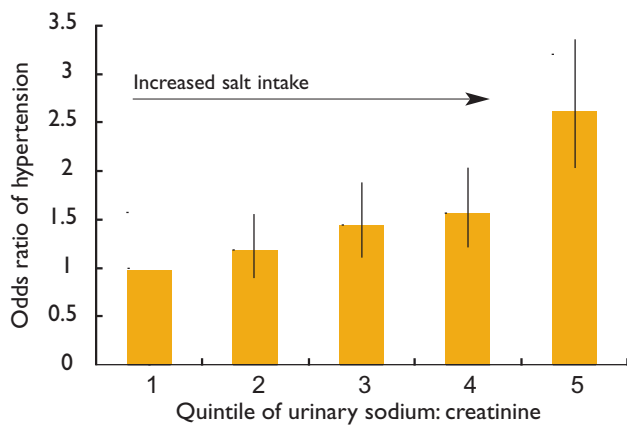
However, the key question for public health is whether a decrease in salt intake can actually reduce blood pressure in humans. A controlled dietary intervention study, the Dietary Approaches to Stop Hypertension (DASH) Trial in the USA showed that reducing total and saturated fat, while increasing the amount of low fat dairy products and boosting fruit and vegetable consumption over a two week run in period and 30 consecutive days, significantly lowered systolic blood pressure (Appel et al 1997).

Figure 6.1a
 Odds ratio of hypertension (systolic blood pressure >160mmHg) in relation to salt intake **in men** aged 45-79y.
 (Data from Khaw et al 2004).



Odds Ratio: Is one of the range of statistics used to assess the risk of a particular outcome (or disease) if a certain factor (or exposure) is present.

Figure 6.1b
 Odds ratio of hypertension (systolic blood pressure >160mmHg) in relation to salt intake **in women** aged 45-79y.
 (Data from Khaw et al 2004).



Following on from this, the DASH Sodium Trial, showed the positive effects of the DASH diet on blood pressure could be enhanced by decreasing salt intake (Sacks et al 2001). A group of 412 adults, including people with and without raised blood pressure, were randomly allocated to follow either the control diet (typical of the US diet) or the DASH diet for three months. During this time they consumed their allocated diet at 3 different levels of salt intake (9g/d, 6g/d and 3g/d) for one month at each level. The diet of the DASH group contained less total and saturated fat and the intake of many micronutrients, including the minerals calcium, magnesium and potassium, was higher.

The results of this trial were very clear (Figure 6.2). Blood pressure decreased progressively as salt intake decreased. In the control group, among people consuming a diet typical of the US population, cutting salt intake from 9g per day to 3g per day reduced systolic and diastolic blood pressure by 6.7 and 3.5mmHg respectively. Among people consuming the DASH diet, blood pressure decreased by 3.0 and 1.6mmHg. The absolute effect of salt reduction on blood pressure was smaller in the DASH group than in the control group, but the two dietary strategies together produced the greatest overall impact. Systolic and diastolic blood pressure on the combined low salt-DASH diet was 8.9 and 4.5mmHg lower respectively than the high salt-control diet. In all studies some people appear to benefit more than others from salt reduction. The term 'salt sensitivity' is sometimes used to describe those people whose blood pressure changes with changes in salt intake.

Cross-sectional Study: A study of a community at one point in time and perhaps stratified by age, sex, ethnicity etc.

Intervention Study: An investigation designed to test a hypothetical cause and effect relationship by modifying a supposed causal factor in a population.

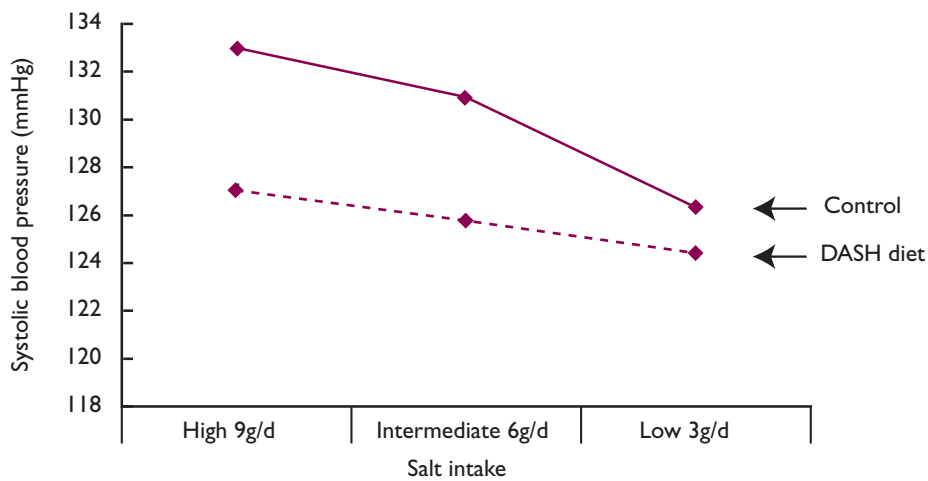
Randomised Controlled Trial: A study in which subjects are assigned to different experimental groups by chance and outcomes are compared after sufficient follow-up time.

Meta-Analysis: This is a statistical analysis that is applied to separate but similar experiments/studies that combines the individual results into a single piece of evidence.

Ecological Study: This type of study compares an index of nutritional status with an index of health status for a group of people. They are usually conducted in the early stages of investigation of a diet: disease relationship.

Prospective Study: A study in which the subjects are identified and then followed forward in time.

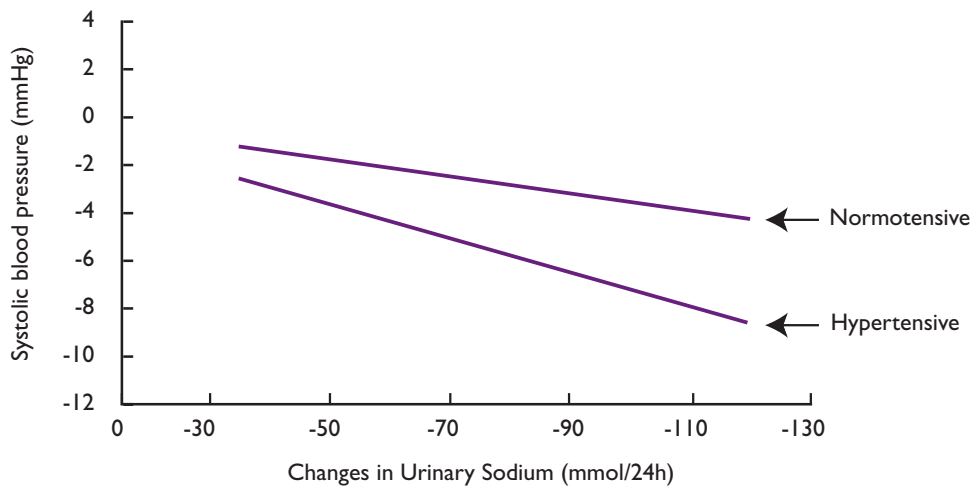
Figure 6.2
Change in systolic blood pressure in response to varying intakes of dietary salt. (Adapted from Sacks et al 2001).



NB Changes within groups at each level of salt intake were significantly different from each other ($p < 0.05$). Differences between control and DASH diet at each level of salt intake were significantly different from each other ($p < 0.05$).

Figure 6.3
The relationship between the net change in urinary sodium excretion and systolic blood pressure. (Adapted with permission from He and MacGregor 2004).

The slope is weighted by an inverse of the variance of the net change in systolic blood pressure.



Conversely those who experience little change are described as 'salt resistant'. However there is no agreed clinical definition and the true prevalence of salt sensitivity is unknown. Since individuals will not be aware of whether or not they are salt sensitive, and since there are no advantages to a high salt intake, it follows that the greatest benefits will be achieved by encouraging the whole population to decrease the average intake of salt.

The DASH Sodium Trial did not select people based on any measure of salt sensitivity. It found reductions in blood pressure in both men and women, across racial groups and in people with and without raised blood pressure. The DASH Sodium Trial is especially important because the diet of the participants was carefully controlled whereas in most other studies people have only received dietary advice on how to reduce their intake of salt. This method offers the optimal approach to determine the effect of diet on blood pressure. In community-based studies of dietary advice, the reductions in salt intake have generally been smaller and poorly sustained. The DASH sodium trial has shown that there is a biological link between salt and blood pressure.

Two meta-analyses concerning the effect of salt intake on blood pressure have been published. The first examined the effect of reductions in dietary salt over at least 4 weeks (He and MacGregor 2004). Only studies in which measurement of 24-hour urinary sodium excretion showed a reduction of 2.4g salt per day or more were included. This review included 17 trials of people with raised blood pressure where there was a median reduction of 4.6g of salt per day and mean blood pressure was reduced by 4.97/2.74 mmHg. In 11 trials of people without raised blood pressure the median reduction in salt intake was 4.4g per day and blood pressure was reduced by 2.03/0.99 mmHg (Figure 6.3). Studies with the greatest reductions in salt also showed the greatest reductions in blood pressure.

The second meta-analysis considered only 11 longer-term trials lasting at least 26 weeks with dietary advice to reduce salt intake (Hooper et al 2002). These studies provided leaflets, cookbooks and individual counselling to help people reduce their salt intake. In the first 6–12 months urinary sodium excretion suggested a decrease of 2.8g salt per day and a reduction in blood pressure of 2.51/1.21 mmHg. In 4 longer trials salt intake was only 2.1g per day lower in the period from 13–60 months. Systolic blood pressure was reduced by 1.12 mmHg but the change in diastolic blood pressure was not significant. In one trial where a subset of participants were followed up after 7 years, sodium excretion had returned to baseline values. The reviewers concluded that long-term maintenance of low salt intake is difficult, even with individual support, advice and encouragement.

CORONARY AND CEREBROVASCULAR DISEASE

High blood pressure is an established risk factor for vascular disease. Decreases in blood pressure would therefore be expected to translate into reductions in coronary heart disease and strokes. There are, however, very few studies in which a direct association has been demonstrated between salt intake and these diseases.

Cross-sectional associations between salt intake and death from stroke have been shown in two large studies. Analysis of data from the Intersalt study showed a significant positive relationship between salt intake (measured by urinary sodium) and death from stroke (Perry and Beavers 1992). In the CARDIAC study (WHO Cardiovascular Disease and Alimentary Comparison) there was a positive association between urinary sodium excretion (measured in a sub-sample of 200 adults) and death from stroke in men (Yamori et al 1994).

There are limited numbers of prospective studies examining the relationship between salt and mortality. A Finnish study examined data from 1173 men and 1263 women (Tuomilehto et al 2001). Over a 10-year period they found a significant increase in all cause mortality, including increased deaths from coronary heart disease and cardiovascular disease, with increasing salt intake (assessed from urinary sodium excretion). When analysed by sex, the increased risk was only significant for men, which the authors suggest was because the number of cardiovascular deaths in women was small. Among men there was an interaction between salt intake and weight status such that the increase in premature mortality was significant for overweight subjects only.

“There is a positive association between urinary sodium excretion and death from stroke in men.”

OTHER POSSIBLE HEALTH EFFECTS

A high salt intake has also been linked to other adverse health effects (DH 1998). Concerns regarding bone health stem from the observation that a high salt intake is associated with increased urinary calcium excretion. It has been estimated that urinary calcium levels increase by approximately 1mmol per 100 mmol sodium intake (Nordin et al 1993). Other concerns include the possibility that a high salt diet might irritate the gastric mucosa. A joint report from the World Health Organisation and Food and Agriculture Organisation Expert Consultation concluded that 'salt-preserved foods and salt probably increase the risk of stomach cancer' (WHO/FAO 2003), although this association is only apparent at much higher levels of salt intake than typically consumed in the UK. More commonly, gastric irritation may increase the risk of infection by *Helicobacter pylori* (Beevers et al 2004).

More research is required to investigate the relationship between salt and other health outcomes. But, when considered alongside the evidence in relation to salt and blood pressure, there is a strong case that reductions in high levels of salt intake will bring overall health benefits.

SUMMARY OF THE EVIDENCE

This evidence shows that high salt intakes are associated with increased blood pressure. Reducing salt intake has been shown to decrease blood pressure in adults of different ages and ethnic background, and in people with and without high blood pressure.

In the context of the UK diet, where the average salt intake is 9.5g per day, and more than twice the RNI, a sustained reduction in salt intake is predicted to decrease the average blood pressure of the population and reduce deaths from vascular disease. Even small changes in blood pressure translate into significant health benefits. For example, it is estimated that a reduction of 2 mmHg in mean diastolic blood pressure will bring a 15% reduction in the risk of stroke and a 6% reduction in coronary heart disease (Cook et al 1995).

The benefits of a reduction in salt intake on blood pressure will be maximised by other lifestyle changes. Achieving an appropriate balance between diet and physical activity will control body weight and reduce the risk of hypertension. More specifically, restricting alcohol intake, consuming a diet rich in low fat dairy products, fruit and vegetables and regular aerobic exercise have all been shown to help reduce blood pressure (Table 6.1).

Table 6.1 Lifestyle interventions for people with hypertension.

Lifestyle Intervention	Average reduction in systolic and diastolic blood pressure	% who achieve a reduction in systolic blood pressure of 10mmHg or more
Healthy weight reducing diet	5–6mmHg	40%
Regular aerobic exercise	2–3mmHg	30%
Combined diet and exercise	4–5mmHg	25%
Relaxation techniques	3–4mmHg	33%
Alcohol within recommended limits	3–4mmHg	30%
Salt reduction to a maximum of 6g per day	2–3mmHg	25%

Source: NICE Guidelines 2004

07



SPECIAL ISSUES FOR INFANTS & CHILDREN

Data relating salt intake to long-term health outcomes for infants and children are limited. However relative to the RNI, the dietary intake of salt is high. It is inadvisable for children to develop a preference for a high salt diet.

For infants, the sodium content of breast milk provides about 0.3–0.4g per day of salt. The ability to excrete sodium in the first six months of life is limited and the sodium content of infant formulae is subject to regulation (Statutory Instrument No.77 1995). For older infants and children the data are sparse. The Reference Nutrient Intakes for sodium, for infants and children over 7 months of age were set using a factorial method to estimate sodium requirements at different stages of growth (DH 1991) (Table 7.1).

Data on the intake of salt among infants and children are derived from the National Diet and Nutrition Survey of pre-school children (1.5–4.5 years) and young people (4–18 years) (Gregory et al 1995; Gregory et al 2000). Measurements of 24-hour urinary sodium excretion are not available and salt intake was estimated from recorded food consumption (Figure 7.1). These figures will be an underestimate as they do not include the addition of salt during cooking or at the table. When questioned, more than one half of the parents of pre-school children report adding salt

when cooking their child's food (Gregory et al 1995) and 63% of young people (4–18 years) add salt during cooking or at the table (Gregory et al 2000).

The mean estimated salt intake of pre-school children is 3.8g per day of salt and 6.1g per day among school-age children. Among school-age children salt intake increases with age, in absolute terms, from 4.9g per day of salt in 4 to 6-year-olds to 6.9g per day of salt in 15 to 18-year-olds. However, expressed in relation to the RNI, salt intakes in 4 to 6 year-olds and pre-school children are proportionally the highest (Figure 7.2). This reflects that fact that at this stage of life, children are transferring to adult-type diets and there is a sharp rise in salt intake.

As for adults, the major sources of sodium in the diets of young people (4–18 years) are cereals (approximately 40%). Meat and their products account for a further 20–25% of sodium intake (Gregory et al 2000) (Figure 7.3).

“Although a small amount of salt is needed in the diet, salt can be very dangerous for infants and should not be added to infant foods; salty foods should also be avoided.”

32 “The increasing prevalence of obesity among young people is exacerbating concerns about high blood pressure and reinforces the need to tackle other contributory factors, including salt.”

Studies on the impact of salt on blood pressure in infants and children are limited. Blood pressure is lower in children than adults and no clinical guidelines exist for the diagnosis of hypertension. However the increasing prevalence of overweight and obesity among young people is exacerbating concerns about high blood pressure and reinforces the need to tackle other contributory factors, including salt. Figure 7.4 gives the salt content of a range of popular children’s foods.

Further research is needed to assess the level of salt in children’s diet, which may influence blood pressure independently of other factors. Nevertheless, it would be inadvisable for children to develop a preference for salt given the evidence to suggest a link between salt intake and blood pressure in adults. SACN has set salt intake targets for infants and children on the same basis as for adults, at 50% above the RNI (Table 7.2).

Table 7.1 RNI for sodium for children.

Age	Sodium RNI mg/d (mmol/d)
0–3 months	9 (210)
4–6 months	12 (280)
7–9 months	14 (320)
10–12 months	15 (350)
1–3 years	22 (500)
4–6 years	30 (700)
7–10 years	50 (1200)
11–14 years	70 (1600)

Source: Department of Health 1991

Table 7.2 Salt intake targets for children.

Age	Target Average Salt Intake g/d	Target Average Sodium Intake g/d
Up to 6 months	Less than 1g	Less than 0.4g
7–12 months	1g	0.4g
1–3 years	2g	0.8g
4–6 years	3g	1.2g
7–10 years	5g	2.0g
11–18 years	6g	2.5g

Source: SACN 2003

Figure 7.1

Salt intake (obtained from weighed food records) in young people. (1.5–4.5 year olds 1992–1993), (4–18 year olds 1997). (Data from Gregory et al 1995 and 2000).

Dashed lines indicate salt reduction targets

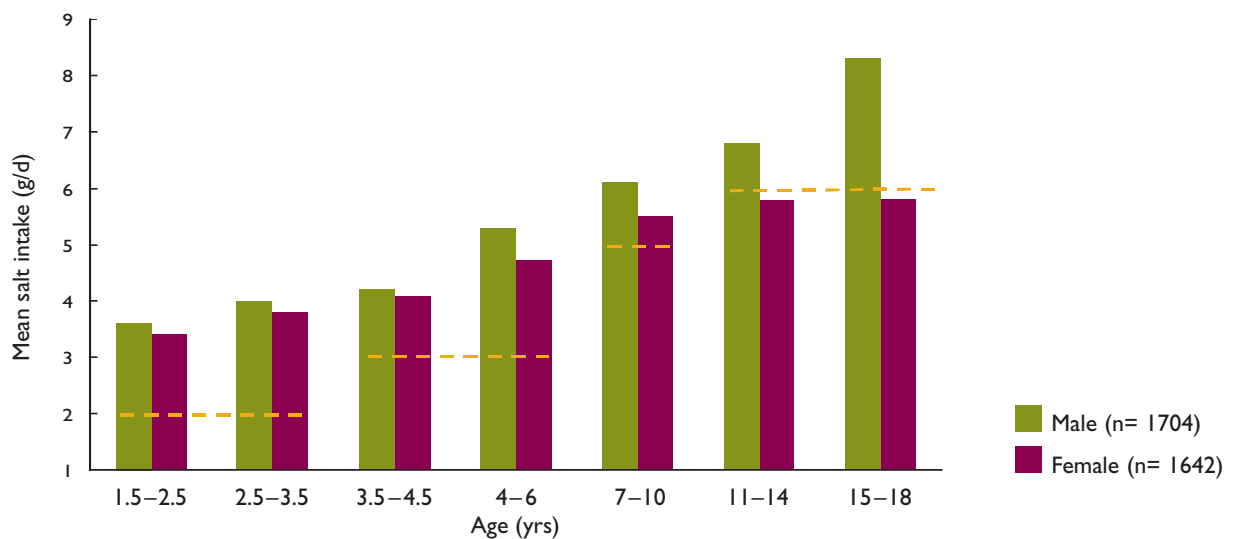
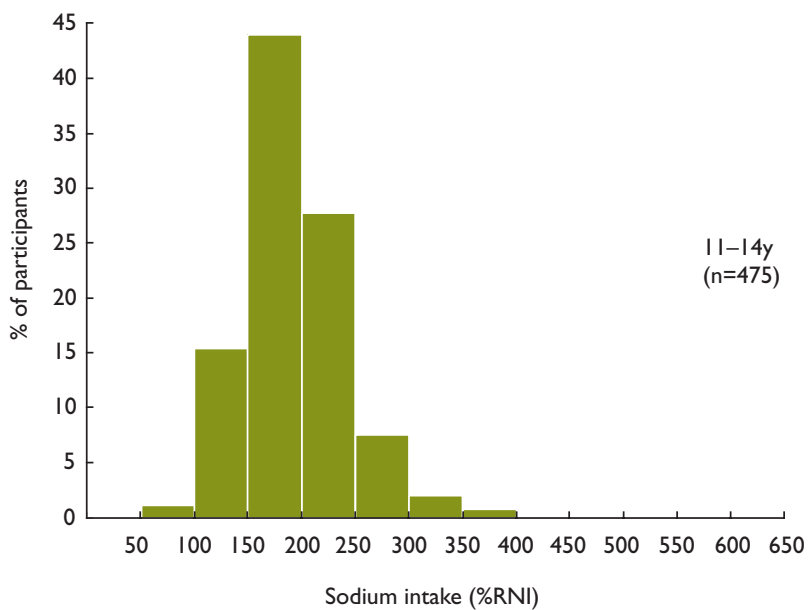
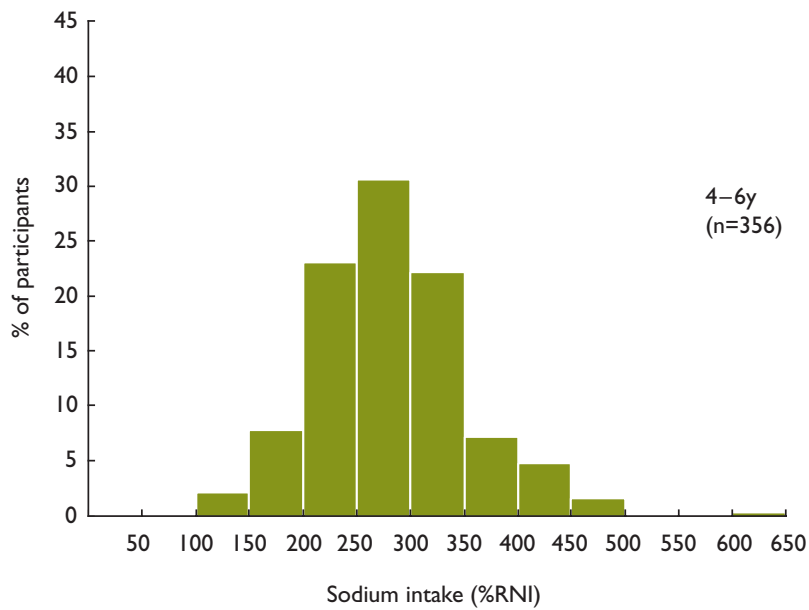


Figure 7.2
Sodium intake (obtained from weighed food records)
in young people. (Data from Gregory et al 2000).



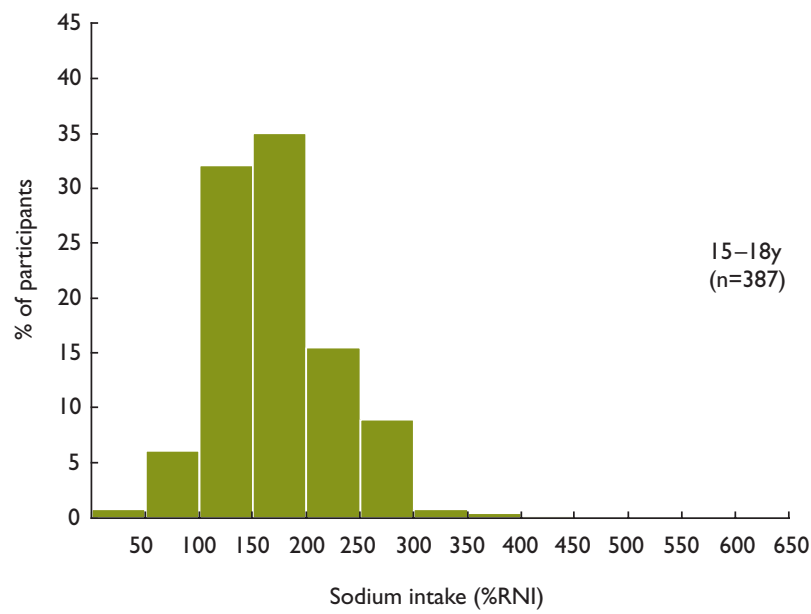
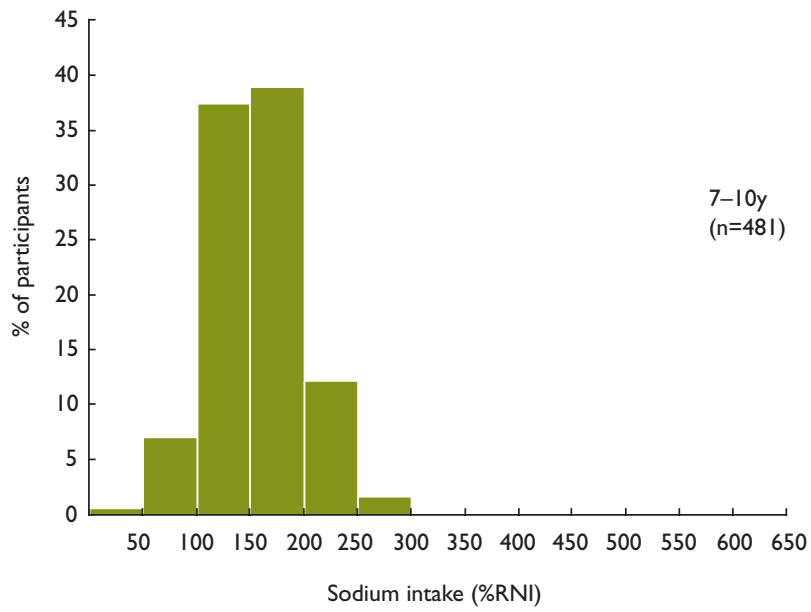
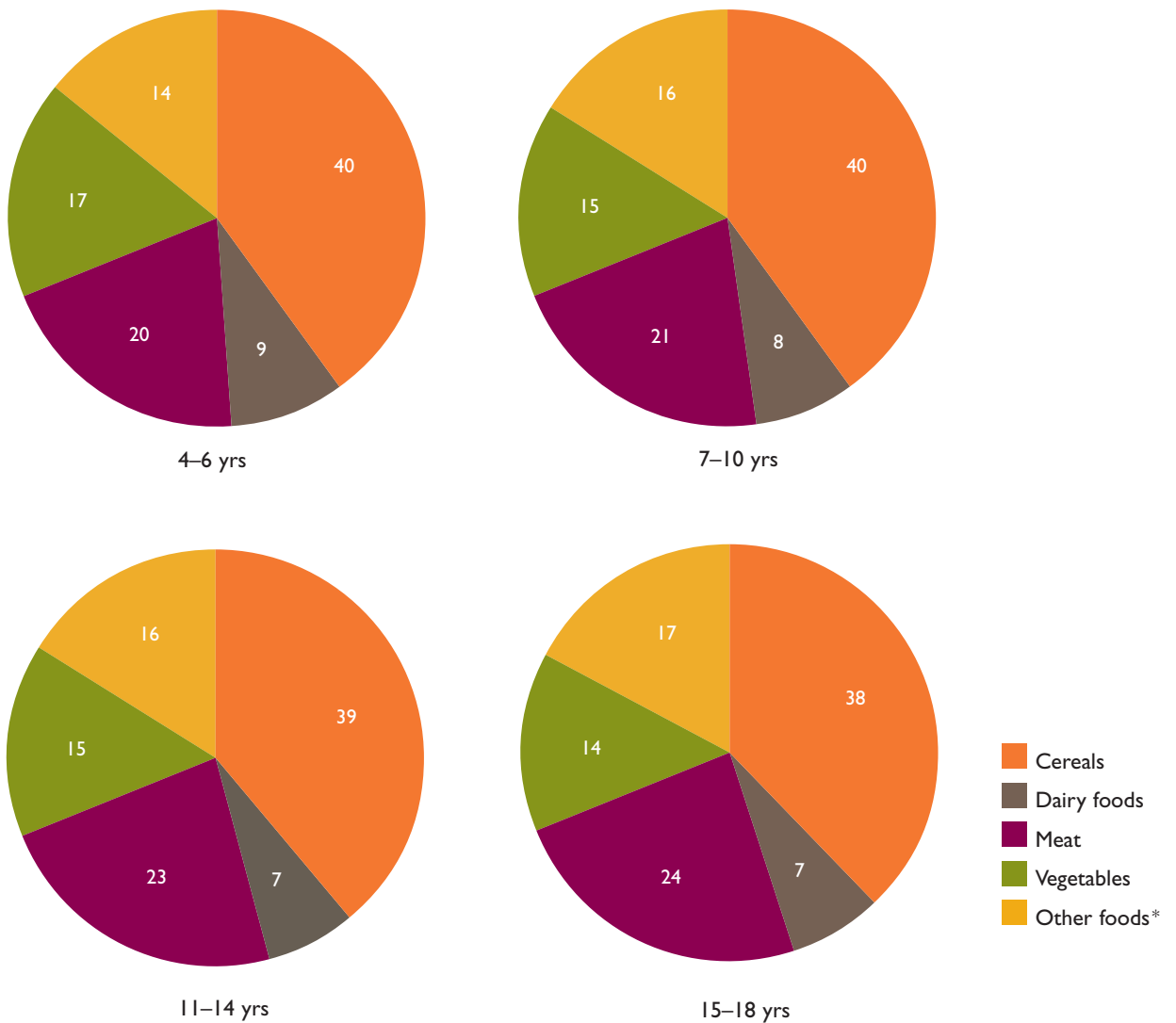


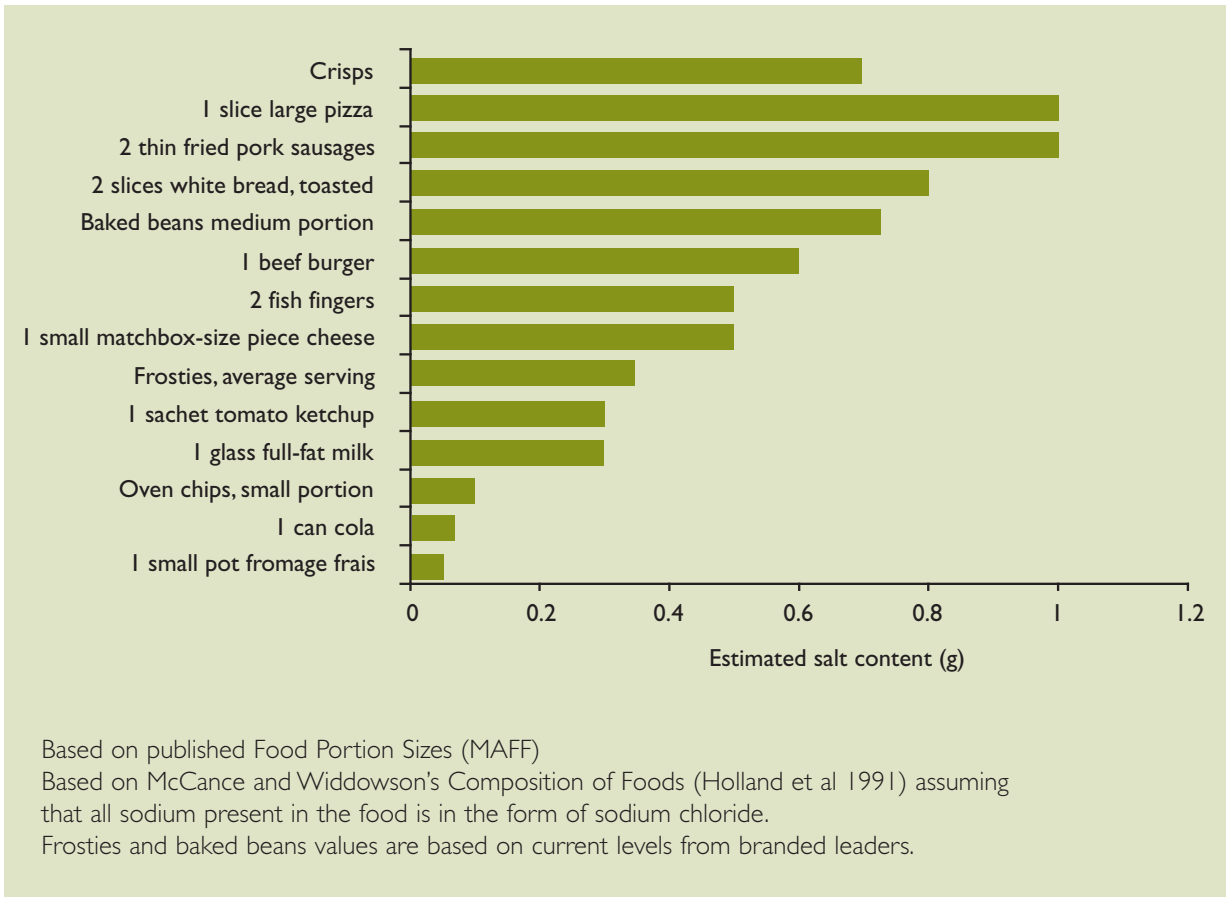
Figure 7.3 Food sources of sodium among young people (n=1701).
(Data taken from Gregory et al 2000).



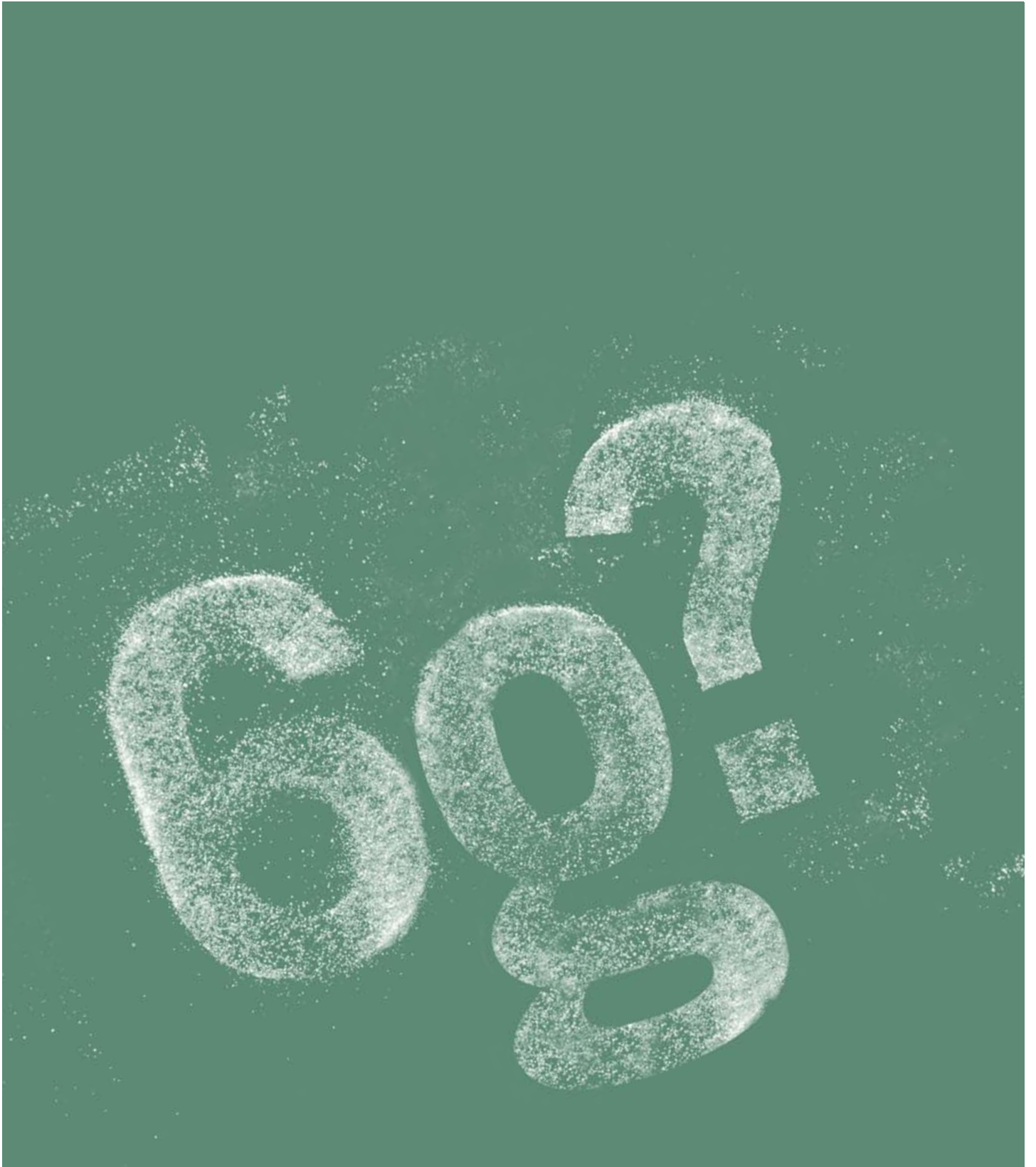
Values in pie sectors indicate percentage contribution.

* Includes eggs and egg dishes, fat spreads, fish and fish dishes, sugar, preserves and confectionery, drinks and miscellaneous foods such as powdered drinks, soups and sauces.

Figure 7.4 Salt content of popular children's foods.



08



WHY 6g?

Six grams per day of salt has been set as the national salt intake target, as part of the broader changes in diet and lifestyle to reduce the risk of cardiovascular disease.

In 1991, COMA set a Reference Nutrient Intake for sodium of 1.6g (70 mmol) for young people over 11 years and adults (DH 1991), which equates to 4g per day of salt. Proportionally lower RNIs were set for infants and children.

However, the average intake of salt for adults is currently more than double the RNI and considerably higher for young children. Figure 8.1 shows the current distribution of salt intake among men and women. Following consultations with experts, policy makers, industry and consumer groups, a salt reduction target to 6g per day for young people over 11 years and adults, was set for 2010. Targets for younger children are proportionally lower. (See section 7, Table 7.2).

These targets represent the first step in a long-term programme of salt reduction designed to reduce the risk of stroke and cardiovascular disease. This is part of a general lifestyle approach to improving health, which includes measures aimed at decreasing intakes of saturated and total fat, reducing smoking and alcohol consumption, and increasing physical activity.

“Our work to improve the nutritional balance of the average diet in England will be directed by the following objective: reduce the average intake of salt to 6g per day by 2010.”

THE 6g PER DAY TARGET WILL BRING HEALTH BENEFITS

Available evidence on the relationship between high salt intake and increased blood pressure, and between high blood pressure and the risk of stroke and cardiovascular disease, predicts that reducing the average intake of salt in the adult population to 6g per day will bring significant improvements in health. It has been estimated that a reduction in current salt intake to 6g per day would predict a 13% reduction in stroke and a 10% reduction in ischemic heart disease (He and MacGregor 2003).

THE 6g PER DAY TARGET IS CHALLENGING BUT ACHIEVABLE

A reduction in salt intake from 9.5 to 6g a day within the next 5 years is an ambitious goal (Figure 8.1). It represents a substantial reduction in salt intake and will require continued co-operation of the food industry and caterers, as well as increased awareness and willingness on the part of individuals to reduce their own salt intake.

THE 6g PER DAY TARGET PROVIDES A MEASURABLE GOAL

Using data from ongoing surveys it will be possible to monitor the progress by manufacturers in reducing the salt content of their products and the net progress towards reducing salt intakes across the population.

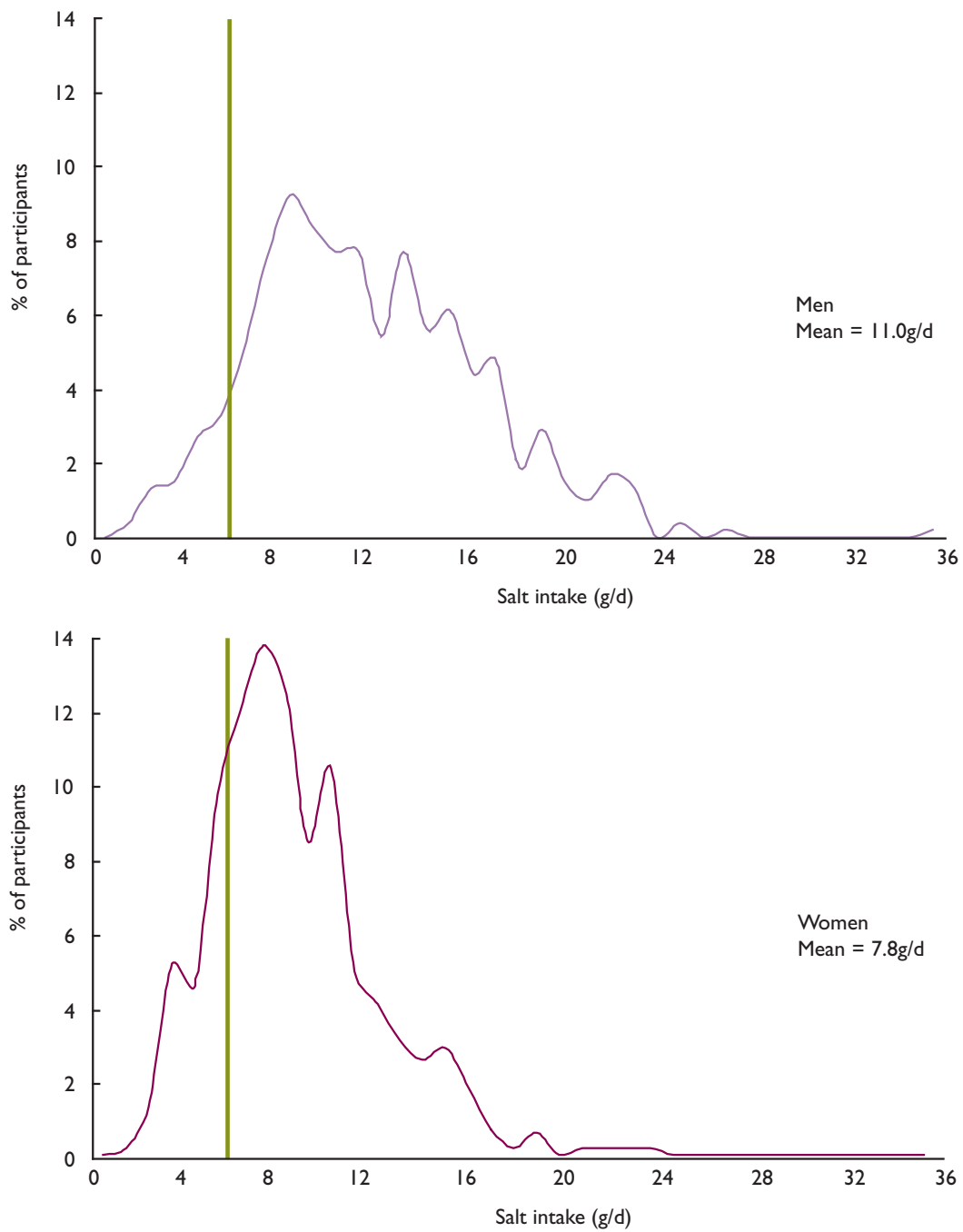
THE 6g PER DAY TARGET IS SPECIFIC

Having a specific goal makes it easier for people to focus on the changes needed in their diet. Without a specific target individuals may be less motivated, particularly as people tend to believe their diet is healthier than it actually is.

“The target salt intake set for adults and children is considered to be an achievable goal for the UK population rather than an optimal or ideal level of consumption.”

Figure 8.1 Distribution of intakes of salt (estimated from 24-hour urinary sodium excretion) of adults in Great Britain (2000/01). (Data from Henderson et al 2003).

Solid green line indicates salt reduction target of 6g/d.



MAKING THE CHANGE

The 6g a day salt intake target is backed by a concerted Government strategy. Effective implementation is critically dependent on the support of both industry and consumers.

Almost three-quarters of total salt intake comes from processed foods. Accordingly, the food industry has a critical role in helping individuals to achieve a lower intake of salt. The Food Standards Agency has developed an illustrative 'salt model' that indicates how decreases in the salt content of various categories of food can together contribute to the achievement of the salt reduction goal. Many food manufacturers, retailers and caterers have already made reductions and/or provided specific commitments to reduce the salt content of their products over the next 5 years.

The impact of these changes in the food supply will be enhanced if they are linked to heightened consumer awareness and understanding of the issues. Consumers need to be motivated to take active steps to reduce their salt intake by choosing items containing less salt, reducing the frequency of consumption and/or portion size of naturally salty foods, using less salt in cooking at home and at the table. Since preferences for salt are acquired, progressive decreases in salt intake are likely to be accompanied by a decline in the perceived palatability of high salt foods.

For maximum impact, action on the part of the food industry and consumers needs to be coordinated. As part of the Government White Paper *'Choosing Health'*, the *Food and Health Action Plan* sets out further details of the partnership needed between Government, industry and consumers to meet the 6g salt intake target.

“The 6g/d target represents the first step in a long-term programme of salt reduction, designed to reduce the risk of stroke and cardiovascular disease.”

The 2010 salt intake targets for adults and children do not represent ideal or optimum consumption levels, but achievable population goals, designed to bring measurable clinical benefits. In the longer term, developments in food technology and changes in acquired food preferences among the population may allow for further reductions.

It has been agreed by all stakeholders that concrete action must be taken by industry and consumers to decrease salt in food. However, while salt is an important risk factor for hypertension, it is not the only dietary component which must be addressed. Decreasing the consumption of total and saturated fat, increasing fruit and vegetable intake, curtailing excess alcohol intake and achieving and maintaining a healthy body weight will all play a role in the greater goal to reduce the morbidity and mortality associated with cardiovascular disease.

Lifestyle measures to reduce hypertension

- Maintain normal weight for adults (body mass index 20–25kg/m²)
- Reduce sodium intake to <100 mmol/day (<6g salt or <2.4g sodium/day)
- Limit alcohol consumption to 3 units/day for men and 2 units/day for women
- Engage in regular aerobic physical exercise (brisk walking rather than weight lifting) for 30 minutes per day, ideally on most of days of the week but at least on three days of the week
- Consume at least five portions/day of fruit and vegetables
- Reduce the intake of total and saturated fat

Source: Williams et al 2004

09



FREQUENTLY ASKED QUESTIONS

Q1. What are the major sources of salt in our diet?

A. The majority of salt in our diet comes from processed foods (60–75%). Natural dietary sources provide about 15%. Salt added at the table or during cooking provides approximately 10%. About 1% is found in tap water. Cereal products, including breakfast cereals, bread, cakes and biscuits provide about one third of the salt in our diet. Meat and meat products such as ham provide just over a quarter of salt in food.

Q2. Why is salt/sodium added to processed foods?

A. Sodium is added to foods either as salt or as a number of other additives. Salt gives food flavour; improves texture (e.g. binding processed meats), improves colour; and helps to preserve it and increases the product's shelf life. In some foods, the addition of salt is inherent to the manufacturing process. For example in cheese where salt regulates the activity of starter cultures and controls the enzyme activity during the maturation process to help suppress the growth of unwanted gas-producing bacteria, thus giving cheese its ultimate flavour and texture.

The Government is currently working with manufacturers to ensure that, where possible, salt levels are gradually lowered in processed foods, making it easier for consumers to select a low salt diet.

Q3. Are salt and sodium the same thing?

A. No. Salt is the common name for sodium chloride, which is the main dietary source of sodium. Other dietary sources of sodium include monosodium glutamate (MSG), sodium citrate and sodium bicarbonate. The adverse health effects of a high salt diet relate to the high sodium intake and not high chloride. A target has been set for salt, but it is important that other sources of sodium do not increase.

Q4. What is considered to be a lot of salt/sodium?

A. A useful guide is shown below:

Per 100g of product

A lot is:	A little is:
1.25g salt	0.25g salt
0.5g sodium or more	0.1g sodium

Q5. What is the average salt intake in the UK?

A. According to the latest national survey published in 2003, on average adults consume 9.5g of salt a day – considerably more than the Government target of 6g per day. Salt intake in young children is proportionally higher.

Q6. What is the reference nutrient intake (RNI) for salt?

A. There is no RNI for salt. The Reference Nutrient Intake (RNI) for sodium (the amount required to meet the needs of 97.5% of the population) equates to 4g per day of salt for young people older than 11 years, and adults. The RNIs for children are proportionally less.

The recommended targets for salt & sodium are given below.

Age	Target Average Salt Intake g/d	Target Average Sodium Intake g/d
Up to 6 months	Less than 1g a day salt	Less than 0.4g sodium
7–12 months	1g a day salt	0.4g sodium
1–3 years	2g a day salt	0.8g sodium
4–6 years	3g a day salt	1.2g sodium
7–10 years	5g a day salt	2.0g sodium
11–18 years	6g a day salt	2.5g sodium
Adults	6g a day salt	2.5g sodium

Source: SACN 2003

Given the very high salt intakes at present, reducing intakes to an average of 6g per day represents an achievable population target that will bring significant clinical benefits in terms of lowering population blood pressure levels which will contribute to reductions in cardiovascular disease. For children under 11 years old, the salt targets are proportionally lower.

Q7. Is it possible to eat too little salt?

A. Sodium balance can be maintained on intakes as low as 69–460mg per day equivalent to 0.175–1.17g salt. Given the abundance of salt in a typical Western diet, it would be difficult to consume less than this amount. Salt requirements may temporarily increase during unaccustomed hard exercise or exposure to very hot climates; however physiological adaptation does occur. Certain disease states such as chronic diarrhoea may result in extreme depletion where acute salt repletion is necessary.

Q8. Should we reduce our intake of other sodium containing compounds for example monosodium glutamate?

A. Yes, the salt reduction campaign aims to reduce the intake of sodium. Monosodium glutamate and other foods also contain sodium and the adverse health effects of a high salt diet are attributable to sodium. Decreases in salt (sodium chloride) in the diet should not be met with increases in other forms of dietary sodium.

Q9. Why do food labels give the sodium content rather than salt?

A. To ensure that the value labelled on a product reflects the total sodium content (i.e. from all additives and preservatives, not just sodium chloride), food labels include sodium rather than salt. To convert this value to salt, you must multiply the value by 2.5:

Salt equivalent = sodium value × 2.5

Q10. Why 6g a day?

A. The Government advises reducing salt intakes from the current average of 9.5g per day to 6g per day. This is regarded as an achievable target and is not intended to reflect optimal or ideal intakes (estimated to be <4g salt/d). It has been estimated that a reduction in current salt intake to 6g per day would predict a 13% reduction in stroke and a 10% reduction in ischemic heart disease (He and MacGregor 2003).

Q11. Can people with high blood pressure benefit from reductions in salt?

A. Yes. Clinical trials show that reductions in salt can help to lower blood pressure. Increasing the consumption of fruit, vegetables and low-fat dairy products at the same time can bring additional benefits.

Q12. What other changes should I make to my diet and lifestyle to reduce the risk of hypertension?

A. Alongside decreasing salt intake significant reductions in blood pressure will be seen if people become more physically active, drink less alcohol, and achieve and maintain a healthy weight.

Q13. Are sea salt and rock salt more nutritious than ordinary table salt?

A. No. Sea salt and rock salt are both forms of sodium chloride and should not be viewed as a healthier alternative to table salt.

Q14. Is potassium chloride a healthier option?

A. Potassium chloride may be used as a salt substitute. Food manufacturers are being encouraged to reduce salt levels by using

less salt in their products rather than using salt substitutes. You should talk to your GP before using salt substitutes containing potassium chloride at home as they are not suitable for some people.

Q15. How can I cook with less salt?

A. Using extra herbs, spices, citrus juices (lemon and lime), mustard or vinegar to flavour foods can allow you to use less salt in many recipes. The Food Standards Agency's salt website (www.salt.gov.uk) also provides useful tips and hints on how to reduce the salt content of foods prepared at home.

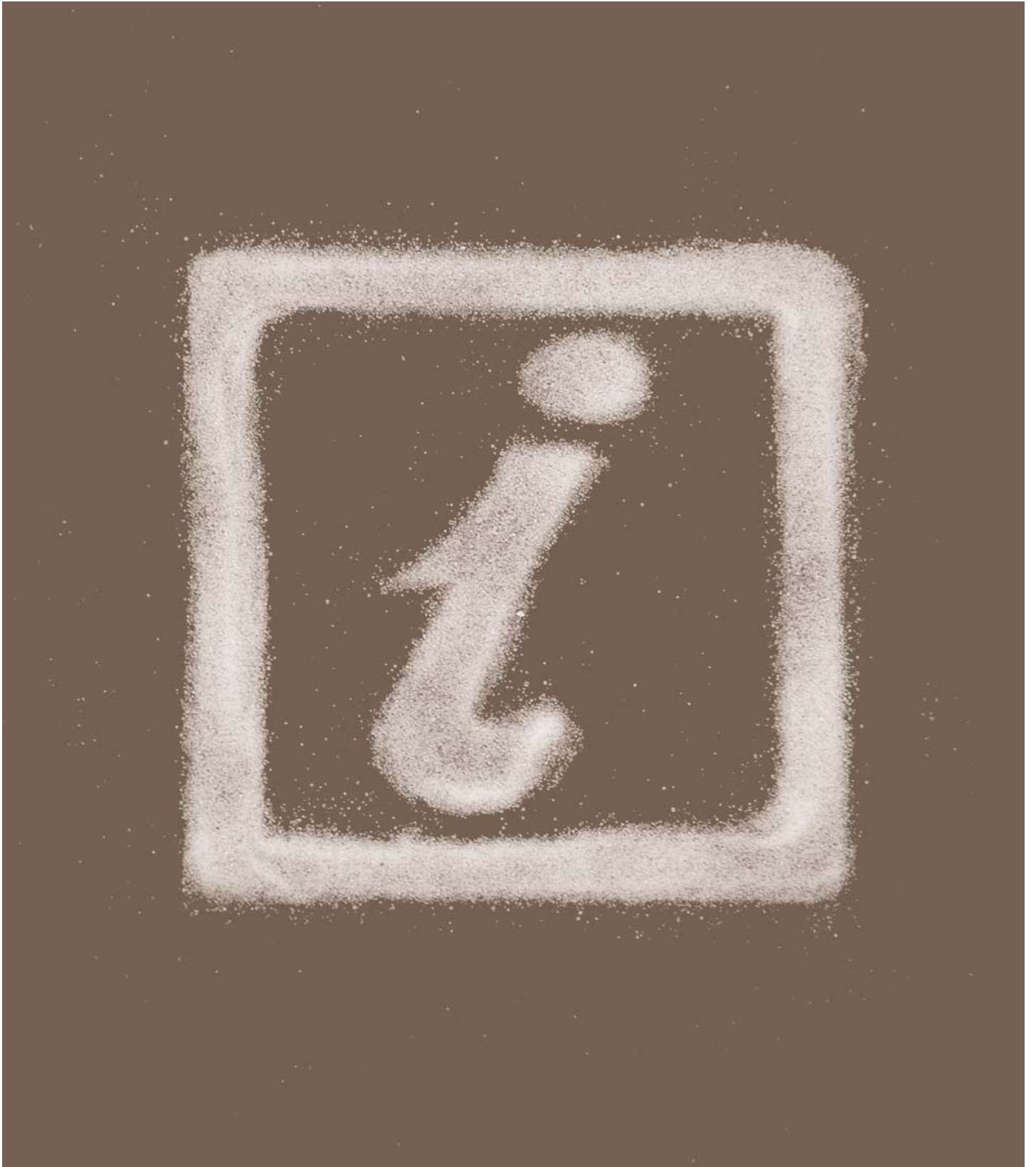
Q16. How can I track my salt intake?

A. Look for products specifically labelled as low salt, which means they must contain less than 40mg sodium per 100g or 100ml, equivalent to 1g of salt. Use food labels to check the amount of salt (or sodium) in other foods. In this way you will be able to identify high salt foods and seek out healthier options. Use online food and salt calculators to check the salt content of commonly eaten foods, particularly those eaten outside the home which will not have a food label, for example fast foods.

Q17. Should I be concerned about the sodium in infant formulae?

A. The sodium content of infant formulae is strictly regulated. Currently only 5 to 14mg of sodium per 100kJ of energy (equivalent to 20 to 60mg of sodium per 100kcal) is permitted. If made up according to the manufacturer's instructions, the amounts that are added are safe for infants to consume.

10



FURTHER INFORMATION

Salt & Health: Scientific Advisory Committee on Nutrition (2003)

A detailed review of science behind the current government recommendations for salt reduction. Includes an executive summary. Available free online from the Food Standards Agency website www.food.gov.uk or purchased from The Stationery Office.

Online information

Visit www.salt.gov.uk for the Food Standards Agency website packed with ideas, tips and information about salt.

Consensus Action on Salt and Health (CASH) www.hyp.ac.uk/cash/ information and scientific papers on salt reduction.

Salt: facts for a healthy heart

Free information guide produced by the British Heart Foundation giving practical advice about lowering sodium intakes. Copies can be downloaded online at www.bhf.org.uk or ordered by calling 020 7486 5820.

Salt and your health

Consumer information leaflet produced by the Food and Drink Federation www.foodfitness.org.uk. Includes information on salt targets, reading labels and how to reduce the salt in your diet.

DASH low-sodium diet information sheets

Doctor and patient information leaflets on the DASH diet are available free of charge from the Doctor Patient Partnership and The Dairy Council. Copies can be ordered online from www.milk.co.uk or by calling 020 7395 4030.

Salt calculator

The Food Standards Agency has an online salt calculator, which allows you to look up the salt content of most foods. This can be accessed via their specialist website www.salt.gov.uk

Easing the pressure: tackling hypertension (2005)

A toolkit for developing a local strategy to tackle high blood pressure produced by the Faculty of Public Health and the National Heart Forum.

Healthy eating and blood pressure

Consumer leaflet from the Blood Pressure Association which can be ordered free of charge by calling 020 8772 4994.

Healthy eating

The Food Standards Agency website for information on fitness, well-being and healthy-eating advice. www.eatwell.gov.uk

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ACKNOWLEDGEMENTS

With thanks to
Dr Ann Prentice,
Mamta Singh,
Nilani Sritharan,
Dr Alison Stephen,
Dr Alison Tedstone
and Chris Thane.

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