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Scientific Advisory Committee on Nutrition

SACN STATEMENT ON POTASSIUM-BASED SODIUM REPLACERS: ASSESSMENT OF THE BENEFITS OF INCREASED POTASSIUM INTAKES TO HEALTH

1) Background

1. High intakes of salt (sodium chloride)[1] have been associated with hypertension (increased blood pressure) which is a major risk factor in the development of cardiovascular disease (CVD). The key evidence for the association between high dietary intakes of salt and hypertension relates to sodium. Since salt is the major source of sodium in the UK diet any recommendation to reduce sodium intake will, in practice, apply to salt reduction.

2. In 1994, the Committee on Medical Aspects of Food Policy (COMA) recommended a reduction in the average intake of salt by the adult population from 9 g/day (equivalent to sodium intake of 157 mmol/3.6 g per day), the current level at that time, to 6 g/day (equivalent to a sodium intake of 104 mmol/2.4 g per day) (COMA, 1994).

3. In 2003, information from national dietary surveys indicated that average salt intakes remained above 6 g/day. Following a review of the evidence (published since 1994) on salt and hypertension, the Scientific Advisory Committee on Nutrition (SACN) agreed with COMA's previous recommendation for a reduction in salt intake to 6 g/day on the basis that this would proportionally lower population average blood pressure levels and confer significant public health benefits by contributing to a reduction in the burden of CVD (SACN, 2003). SACN advised that this would be best achieved using a population-based approach through the adoption of a healthy balanced diet, low in salt and saturated and total fat and rich in fruit, vegetables and complex carbohydrates. The committee also advised that a reduction in the salt content of processed food and drinks would be necessary and require the continued co-operation of food manufacturers, retailers, and caterers.

4. Since 2003, food companies have been reformulating foods to reduce their salt content and this has contributed to reducing the UK population's average salt intake. However, intakes remain above 6 g/day (Bates et al., 2016a). The food industry continues to find ways to reduce the amount of salt in processed foods, including the use of salt and sodium replacers based on potassium e.g. potassium chloride and potassium-based raising agents.

5. The Department of Health (DH), which was responsible for policy in this area until responsibility was transferred to Public Health England in 2016, has not recommended the use of salt or sodium replacers by industry or consumers. Food manufacturers were encouraged to reduce salt levels by using less salt in their products so that consumers' palates could become used to lower salt levels across all foodstuffs. In addition there were concerns that increasing potassium intakes could result in adverse effects on individuals with compromised kidney function.

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[1] Salt comprises 40% sodium and 60% chloride; 3 1 g of sodium is equivalent to 2.55 g salt (2.5 g is used by industry for labelling purposes); 1 mmol sodium is equivalent to 23 mg sodium.

6. However, members of the food industry asked DH to reconsider this. Therefore, in 2013, DH requested SACN provide advice on the potential risks and benefits of reducing the salt (sodium) content of foods through the use of potassium-based sodium replacers, ingredients, and additives.

7. The purpose of this position statement is to provide a summary of the potential benefits to the general population of replacing sodium with potassium based sodium replacers and increasing potassium intakes.

8. A literature search was undertaken to identify evidence examining the relationship between potassium intake and relevant health outcomes, including blood pressure, CVD and bone health. In keeping with SACN's *Framework for the evaluation of evidence*, this assessment is based primarily on evidence provided by systematic reviews and meta-analyses of randomised controlled trials (RCTs) and prospective cohort studies.

9. SACN asked the Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (COT) to assess the potential risks. The COT statement on *Potassium-based replacements for sodium chloride and sodium-based additives* (COT, 2017) is available here. Advice based on the independent position statements of SACN and COT has been brought together as an integrated position statement, *Potassium-based sodium replacers: assessment of the health benefits and risks of using potassium-based sodium replacers in foods in the UK*.

10. In addition, the Food Standards Agency (FSA) has modelled UK population potassium intakes resulting from the use of potassium-based sodium replacers in foods (SACN/COT, 2017). The results of the modelling are summarised in paragraphs 65-68.

2) Biology and metabolism

11. Potassium is an essential nutrient, present in all animal and plant tissues and is found in most types of food (fruits, vegetables, milk, nuts and seeds, fish and meat). Its metabolism and functions are interrelated to those of sodium. Together they are essential for the maintenance of normal osmotic pressure in body fluids and the physiological functioning of nerve and muscle cells.

12. Potassium concentration in the body is maintained by the kidneys, which remove any potassium that is in excess of requirements. Normal blood potassium concentrations are 3.6-5.2 mmol/L. Renal regulation of potassium is closely related to sodium homeostasis.

13. Details on physiology, absorption, distribution, excretion and regulation of potassium concentration are provided in the COT statement.

3) Current recommendations for potassium

14. In 1991, COMA set Dietary Reference Values (DRVs) for potassium (COMA, 1991). DRVs provide benchmark levels of nutrient requirements in the UK. The DRVs include a Reference Nutrient Intake (RNI)[2] and a Lower Reference Nutrient Intake (LRNI)[3]. Details of how the DRVs were derived are provided in the COMA report. The RNIs and LRNIs for potassium by age group are given in the table below.

Dietary reference values for potassium

Age	RNI	LRNI
	mmol/d (mg/d)	
0-3 months	20 (800)	10 (400)
4-6 months	22 (850	10 (400)
7-9 months	18 (700)	10 (400)
10-12 months	18 (700)	12 (450)
1-3 years	20 (800)	12 (450)
4-6 years	28 (1100)	15 (600)
7-10 years	50 (2000)	24 (950)
11-14 years	80 (3100)	40 (1600)
15-50+ years	90 (3500)	50 (2000)

4) Recommended upper intake levels for potassium

15. In 2003, the Expert Group on Vitamins and Minerals (EVM) recommended maximum advisable levels of intake for vitamin and mineral supplements (EVM, 2003). Safe Upper Levels (SUL), which represent an intake that can be consumed daily over a lifetime without significant risk to health, were established when supported by sufficient data. A Guidance Level (GL) was set when there was insufficient evidence to establish a SUL. GLs represent an approximate indication of intakes that would not be expected to cause adverse effects.

16. The EVM concluded that the available data were not adequate to establish a SUL for potassium. Regarding a GL, the EVM concluded that supplemental potassium doses of up to 95 mmol/day (3700 mg/day) appeared to be without overt adverse effects but may be associated with gastrointestinal lesions diagnosed by endoscopy. Since the effect appeared to relate to ingestion of potassium supplements rather than potassium in food, a GL for *total* potassium intake was not set. The EVM concluded that an extrapolation of the GL to children on a bodyweight basis may be inappropriate.

[2] The RNI is the amount of a nutrient that is sufficient to meet the needs of most (97.5%) of the population.
[3] The LRNI is the amount of a nutrient that is sufficient to meet the needs of only 2.5% of the population

5) Assessment of potassium intakes in the UK

17. Potassium intakes in the UK are measured as part of the National Diet and Nutrition Survey (NDNS) rolling programme. Results of years 5-6 combined were published in September 2016 (Bates et al., 2016b) and relevant results are provided in Annex 1, Tables 1-4.

18. Representative data for Scotland, Northern Ireland and Wales were obtained from the NDNS Scotland report 2008/09-2011/12 (Annex 1, Tables 6-9) (Bates et al., 2014), Northern Ireland report 2008/09-2011/12 (Annex 1, Tables 11-14) (Bates et al., 2015a), and Wales report 2009/10-2012/13 (Annex 1, Tables 16-19) (Bates et al., 2015b).

19. In the NDNS rolling programme, diet was assessed by a food diary of all foods and drinks consumed over four consecutive days. Since dietary surveys are reliant on self-reported measures of intake, misreporting of food consumption (generally under-reporting) is an issue in all dietary surveys, including the NDNS. This is an important consideration in the interpretation of the findings.

Dietary sources of potassium

20. The main dietary sources of potassium in the UK were vegetables and potatoes, milk and milk products, cereals and cereal products, and meat and meat products (Annex 1, Table 5).

21. For children aged 1.5-3 years, milk and milk products were the main source of potassium, providing 32% of intake. For children aged 4-10 years, vegetables and potatoes, milk and milk products, and cereals and cereal products each provided 17-21% of total potassium intake and for children aged 11-18 years, vegetables and potatoes provided 24% of intake.

22. For adults aged 19-64 years, vegetables and potatoes provided 24% of intake, meat and meat products 17% of intake, and cereal and cereal products 15% of intake. For adults aged 65 years and over, vegetables and potatoes provided 24% of intake, cereal and cereal products, meat and meat products, and milk and milk products each provided 13-15% of potassium intake.

23. The main contributors of potassium to the diet were very similar in Scotland, Northern Ireland and Wales (Annex 1, Tables 10, 15 & 20 respectively) to those for the UK as a whole. Milk and milk products provided 29%, 30% and 29% of potassium intake in children aged 1.5-3 years in Scotland, Northern Ireland and Wales respectively. Vegetables and potatoes were the main contributors to potassium intake in the other age groups providing around 20-27%.

Potassium intakes

24. For the majority of age groups, reported mean potassium intakes in the UK were below the RNI, with only boys and girls aged 1.5-10 years consuming more than the RNI on average (Annex 1, Table 1 & 2). For adolescents aged 11-18 years, mean potassium intakes were 77% and 65% of the RNI for boys and girls respectively. Men aged 19-64 years and 65 years and over had mean potassium intakes at 88% and 84% of the RNI, while women aged 19-64 years and 65 years and over had mean intakes at 73% and 74% respectively of the RNI.

25. Potassium intakes in Scotland, Northern Ireland and Wales were similar to those for the UK as a whole, with children aged 1.5-10 years consuming more potassium than the RNI on average (Annex 1, Tables 6, 11 & 16 respectively). In Scotland, mean potassium intakes for adolescents aged 11-18 years, adults aged 19-64 years, and adults 65 years and over were 68%, 77%, and 76% respectively of the RNI. In Northern Ireland, mean potassium intakes for adolescents aged 11-18 years, adults aged 19-64 years, and adults 65 years and over were 71%, 76%, and 77% respectively of the RNI. In Wales, mean potassium intakes for adolescents aged 11-18 years, adults aged 19-64 years, and adults 65 years and over were 69%, 78%, and 75% respectively of the RNI.

26. The UK population group with the highest proportion of individuals with intakes below the LRNI was adolescents aged 11-18 years, of which 15% of boys and 33% of girls had intakes below the LRNI (Annex 1, Table 3). Eleven percent of men and 26% of women aged 19-64 years had intakes below the LRNI and 9% and 24% of men and women aged 65 years and over had intakes below the LRNI.

27. In Scotland, 15% of boys and 41% of girls aged 11-18 years, 14% of men and 26% of women aged 19-64 years, and 11% of men and 27% of women aged 65 years and over had intakes below the LRNI (Annex 1, Table 8). In Northern Ireland, 12% of boys and 36% of girls aged 11-18 years, 13% of men and 24% of women aged 19-64 years, and 15% of adults aged 65 years and over had intakes below the LRNI (Annex 1, Table 13). In Wales, 17% of boys and 39% of girls aged 11-18 years, 13% of men and 24% of women aged 19-64 years, and 19% of men and 32% of women aged 65 years and over had intakes below the LRNI (Annex 1, Table 18).

6) Nutritional considerations of the effects of potassium on health

28. This paper summarises evidence from systematic reviews and meta-analyses of published RCTs and prospective cohort studies relating to effects of potassium on blood pressure, CVD (especially stroke), and bone health. Evidence from individual RCTs has also been included where systematic reviews or meta-analyses are lacking. Details of the included meta-analyses are provided in Annex 2 and a table of studies included in each meta-analysis is provided in Annex 3.

Potassium salts used in studies

29. No evidence was identified that specifically assessed the effect of potassium-based sodium replacers in foods on any health outcome. For this reason, evidence was based on meta-analyses of RCTs that, in most cases, used potassium supplements or prospective cohort studies that assessed dietary potassium intake. Reviews that only included RCTs that increased potassium intake through dietary sources (for example, fruit and vegetables) were excluded. The CVD reviews only included prospective cohort studies and therefore the focus was on dietary sources of potassium.

30. The supplements used in the studies considered below contained potassium bicarbonate, potassium chloride or potassium citrate. The majority of the trials included in the blood pressure systematic reviews used potassium chloride supplements as the intervention. Only a small number of trials used potassium citrate, potassium bicarbonate or potassium from the diet as the intervention (see Annex 3). The studies in the bone health systematic review used potassium bicarbonate and potassium citrate.

31. Most studies report potassium intake/dose in mmol/day.[4]

Systematic reviews/meta-analyses on potassium and health

<u>Blood pressure</u>

32. An early meta-analysis by Whelton et al. (1997) included 30 RCTs with 33 comparisons on potassium intake and blood pressure. Twenty one trials were undertaken in participants with hypertension and 12 in participants without hypertension. The majority of trials used potassium chloride (ranging from 17-120 mmol/day) as the intervention; 2 trials compared potassium chloride with either potassium citrate or bicarbonate (75-120 mmol/day) and 4 trials used potassium from the diet (100-200 mmol/day). Pre-treatment urinary potassium ranged from 39 to 79 mmol/day and the mean net increase in urinary potassium from pre-treatment to end of follow-up ranged from 12 to 129 mol/day. The duration of the trials ranged from 4 days to 2 years, with a median of 5 weeks. Twenty four of the trials were placebo controlled. In the 9 trials that were not placebo controlled, 4 gave both treatment groups potassium but the intervention group received a higher dose; in the other 5 trials, the intervention and control groups were maintained on similar diets but the intervention group were concurrently given potassium supplements.

33. When the results from all trials were combined, increased potassium intake resulted in a significant decrease in systolic blood pressure (SBP) (-4.44 mm Hg; 95% CI -2.53, -6.36; $p< 0.001$); and diastolic blood pressure (DBP) (-2.45 mm Hg; 95% CI -0.74, -4.16; $p< 0.01$). After excluding an outlier trial which included Kenyan participants with an unusually high baseline blood pressure resulting in a much larger treatment effect

[4] 1mmol = 39.1mg potassium

than reported in other trials (Obel, 1989), the decrease was reduced but remained significant (SBP -3.11 mm Hg, $p < 0.001$; DBP -1.97 mm Hg, $p < 0.001$). When results from participants with and without hypertension were analysed separately, they remained significant except for SBP in participants without hypertension.

34. The effect tended to be greater in those with higher sodium excretion. Thirty RCTs in the meta-analysis by Whelton et al. (1997) included data on urinary sodium excretion during follow-up (range 28-221 mol/day; median 150 mmol/day). There was a significant treatment related reduction in SBP and DBP as urinary sodium excretion was greater during follow-up (< 140 mmol/day to ≥ 165 mmol/day). The reduction in SBP was -1.2 mm Hg to -7.3 mm Hg ($p < 0.001$) at urinary sodium excretion < 140 mmol/day and ≥ 165 mmol/day respectively. For DBP the change in blood pressure was 0.1 mm Hg and -4.7 mm Hg ($p < 0.001$) at urinary sodium excretion < 140 mmol/day and ≥ 165 mmol/day respectively.

35. Geleijnse et al. (2003) included 27 RCTs in a meta-analysis investigating potassium intake and blood pressure in participants with and without hypertension. The majority of the trials used potassium chloride as the intervention (17-120 mmol/day) with 3 trials using potassium from the diet (≥ 100-200 mmol/day). Trials included in the meta-analysis had a minimum duration of 2 weeks. An increase in potassium intake of 44 mmol/day resulted in a significant decrease in SBP (-2.42 mm Hg; 95% CI -3.75, -1.08) and DBP (-1.57 mm Hg; 95% CI -2.65, -0.50; p-values not reported) in participants with and without hypertension combined. When separate meta-analyses were undertaken, the reduction in blood pressure was significant in participants with hypertension (SBP: -3.51 mm Hg (95% CI -5.31, -1.72); DBP: -2.51 mm Hg (95% CI -2.51 (95% CI -3.96, -1.06), p-values not reported) but not in those without hypertension (SBP: -0.97 mm Hg, 95% CI -3.07, 1.14; DBP: -0.34, 95% CI -2.04, 1.36). Initial 24-hour sodium excretion had no significant interaction with blood pressure during potassium supplementation.

36. A Cochrane meta-analysis (Dickinson et al., 2006) of RCTs with an intervention period of at least 8 weeks evaluated the effects of potassium supplements in adults with high blood pressure (SBP > 140 mm Hg or DBP > 85 mm Hg) who were not receiving anti-hypertensive medication. Five trials (n=425) were included in the meta-analysis. In 1 trial, potassium intake was increased through the diet (≥ 100 mmol/day), 3 trials used potassium chloride (48-120 mmol/day) and 1 used potassium citrate and potassium bicarbonate (120 mmol/day) supplements as the intervention. There was no significant effect of potassium supplementation on SBP (-11.2 mm Hg; 95% CI -25.2, 2.7; $p=0.11$) or DBP (-5.0 mm Hg; 95% CI -12.5, 2.4; $p=0.19$). Sodium intake/excretion was not considered in this meta-analysis.

37. Since there was substantial heterogeneity between trials, a number of sensitivity analyses were performed. Removing the outlier trial (in Kenyan participants with an unusually high baseline blood pressure resulting in a much larger treatment effect

than reported in other trials) (Obel, 1989) from the meta-analysis maintained a non-significant effect on SBP (-3.9 mm Hg; 95% CI -8.6, 0.8; p=0.11) and on DBP (-1.5 mm Hg; 95% CI -6.2, 3.1; p=0.52). Additional sensitivity analysis restricted to 2 high quality trials (n=138) also reported a non-significant reduction in both SBP and DBP and considerable heterogeneity remained between trials (I^2= 87%). The authors concluded that while there was no significant reduction in blood pressure, results from the trials varied considerably and, as most were of poor quality (e.g. concealment of allocation was unclear), they may not have been reliable.

38. The World Health Organisation (WHO) issued new guidance on dietary salt and potassium in 2013, which included a meta-analysis of trials investigating the effect of potassium intake on CVD risk factors, including blood pressure (Aburto et al., 2013). Twenty one RCTs investigating potassium intake and blood pressure were included in the meta-analysis: 3 trials were in participants without hypertension, 17 in participants with hypertension and 2 in participants with mixed hypertension-status. The majority of trials used supplements in their intervention arm; 2 trials used dietary advice or education. Potassium intake ranged between < 90 to > 155 mmol/day from supplements and between 20 to ≥ 100 mmol/day from the diet. Increased potassium intake significantly reduced SBP by 5.93 mm Hg (95% CI 1.70, 10.15) and DBP by 3.78 mm Hg (95% CI 1.43, 6.13) (p-values not reported).

39. Since there was considerable heterogeneity in the meta-analyses of SBP and DBP (I^2 of 96% and 93% respectively) the authors removed 1 trial at a time from the meta-analysis. Removing the trial by Obel (1989) reduced I^2 to 65% for SBP and removal of 2 trials (Obel, 1989; Patki et al., 1990) reduced I^2 for DBP to 55%. SBP was still significantly reduced by 3.49 mm Hg (95% CI 1.82, 5.15) and DBP by 1.96 mm Hg (95% CI 0.86, 3.06).

40. When the results for participants with and without hypertension were analysed separately the reduction was no longer significant in participants without hypertension. However, the magnitude of the beneficial effect of potassium on blood pressure was greater in the participants with hypertension than in all participants (SBP -5.32 mm Hg; DBP -3.10 mm Hg; p-values not reported). In a subgroup analysis by achieved potassium intakes (< 90 mmol/day, 90-120 mmol/day, 120-155 mmol/day and > 155 mmol/day) there was no significant difference in blood pressure between groups. The greatest decrease in SBP (6.91 mm Hg; 95% CI 2.29, 11.53; p-value not reported) was in the group of trials with the highest sodium intake (> 174 mmol/day; 4000 mg/d; equivalent to 10 g/d of salt), but this was not significantly greater than that seen in the group of trials where sodium intake was 87-174 mmol/day (2000-4000 mg/day; equivalent to 5-10 g/d of salt) (1.97 mm Hg; 95% CI 0.52, 3.41; p-value not reported).

41. Binia et al. (2015) assessed the effect of daily potassium intake on blood pressure in patients with and without hypertension (not on hypertensive treatment). Fifteen RCTs

were included in the meta-analysis (10 in participants with hypertension and 5 in participants without hypertension or with mixed hypertension status). Thirteen of the RCTs used potassium chloride (30-200 mmol/day) as the intervention, 1 used potassium citrate (40 mmol/day) and 1 compared a high potassium diet with a normal[5] diet. Potassium supplementation significantly reduced SBP by 4.7 mm Hg (95% CI 2.4, 7.0; p< 0.001; I^2=79.7%) and DBP by 3.5 mm Hg (95% CI 1.3, 5.7; p=0.002; I^2=91.1%) when participants with and without hypertension were analysed together. A greater effect was reported when participants with hypertension were analysed separately with a reduction in SBP of 6.8 mm Hg (95% CI 4.3, 9.3; p< 0.001) and in DBP of 4.6 mm Hg (95% CI 1.8, 7.5; p=0.001). However, substantial heterogeneity was present in both meta-analyses (SBP: I^2=54.1%; DBP: I^2=87.4%).

42. In the majority of the trials, sodium intake was between 87 and 174 mmol/day (2000 and 4000 mg/d; equivalent to 5 and 10 g/d salt) at baseline. Sodium intake was above 174 mmol/day (4000 mg/day; equivalent to 10 g/d of salt) in 4 trials and below 87 mmol/day (2000 mg/day; equivalent to 5 g/d of salt) in 1 trial. Sodium intake did not change significantly following intervention in any of the trials included in the analysis (as indicated by measurement of 24h urinary sodium excretion).

Blood pressure in children

43. Aburto et al. (2013) reviewed 2 RCTs, 1 non-randomised controlled trial, and 1 cohort study. Meta-analysis of the trials reported no significant effect of potassium supplements on SBP (0.28 mm Hg; 95% CI -0.49, 1.05; p=0.47) or on DBP (0.92 mm Hg; 95% CI -0.16, 2.00; p-value not reported). The cohort study reported that compared to the lowest third of potassium intakes, the highest third had a 1.00 mm Hg (95% CI 0.35, 1.65; p-value not reported) per year lower increase in blood pressure. These findings were based on limited data and the authors considered the evidence to be at high risk of bias.

Cardiovascular disease health outcomes

44. The systematic review by Aburto et al. (2013) also investigated the association between potassium intake and all-cause mortality, CVD, stroke and coronary heart disease (CHD). Eleven prospective cohort studies (n=127,038) were included. Meta-analysis of 9 of these studies reported that higher potassium intake was associated with a significantly reduced risk of incident stroke (RR, 0.76; 95%CI 0.66-0.89; p< 0.001).

45. No significant association was reported for potassium intake and either incident CVD (RR 0.88; 95% CI 0.70-1.10; p=0.27; based on a meta-analysis of 4 cohorts) or CHD (RR 0.96; CI 0.78-1.19; p=0.72; based on a meta-analysis of 3 prospective cohort studies). Two prospective cohort studies assessed the association between potassium

[5] Normal as defined in the cited papers and not stated as a specific level of intake.

intake and all-cause mortality but data from these studies could not be pooled as 1 did not report an estimate of variance.

46. A meta-analysis by Larsson et al. (2011) investigated the association between potassium intake and risk of stroke. The meta-analysis included 10 prospective cohort studies, with 8,695 cases of stroke (n=268,276). A dose-response analysis reported that each additional 26 mmol/day[6] increase in potassium intake resulted in an 11% reduced risk of stroke (RR 0.89; 95% CI 0.83-0.97; p-value not reported).

47. A meta-analysis by D'Elia et al. (2011) investigated the association between potassium intake and the risk of stroke, CHD and total CVD. Eleven studies were included in the meta-analyses involving participants (247,510) from 6 countries; 11 studies were included in analysing the association with stroke, 6 for CHD and 4 for CVD. Average intakes of potassium ranged between 45 and 85 mmol/day except in 1 study (125 mmol/day). A higher intake of potassium (average weighted difference of 42 mmol/day) was associated with a significantly reduced risk of stroke incidence (RR, 0.79; 95% CI, 0.68-0.90); p=0.0007); however, there was significant heterogeneity between studies (I^2=55%). No significant association was reported for potassium intake and CVD risk (RR, 0.85; 95% CI, 0.62-1.16; p=0.31) or CHD (RR, 0.92; 95% CI, 0.81-1.04; p=0.18). The authors reported that the analyses were limited by inaccurate estimates of habitual potassium intake which were available only at baseline and by the methods used: only 3 out of the 11 studies measured potassium intake by 24-hour urine collection. In addition, the authors noted that not all studies had adjusted for potential confounders and that only 4 had reported risk adjusted for sodium intake, considered to be a relevant confounder of the effect of potassium.

48. An update of this meta-analysis (D'Elia et al., 2014), which included 3 additional studies, reported a similar reduction in stroke risk (RR, 0.80; 95% CI 0.72, 0.90; p-value not reported) with reduced heterogeneity between studies (I^2=47%). A dose-response analysis reported that each additional increase of 26 mmol/day (1000 mg/day) in potassium intake was associated with a 10% reduced risk of stroke.

<u>Bone health</u>

49. A meta-analysis examining the effects of supplemental alkaline potassium salts on calcium metabolism and bone health (Lambert et al., 2015) included 14 RCTs and metabolic studies. Outcome measures were urinary calcium excretion, markers of bone resorption and formation, bone mineral density (BMD) and net acid excretion (NAE). Seven studies used potassium bicarbonate (30-120 mmol/day) and 7 used potassium citrate (40-9 mmol/day) as the intervention.

[6] 1mmol = 39.1mg potassium

50. Both potassium bicarbonate (SMD[7] -1.03; 95% CI -2.03, -0.03; p=0.04; I^2=93%) and potassium citrate (SMD -1.03; 95% CI -1.85, -0.21; p=0.01; I^2=90%) supplements decreased urinary calcium excretion compared to placebo. There was also an effect of potassium bicarbonate supplements (SMD -5.73; 95% CI -9.30, -2.16; p=0.002; I^2=95%) and potassium citrate supplements (SMD -4.88; 95% CI -7.73, -2.04; p=0.0008; I^2=97%) on NAE. Both potassium citrate supplements (SMD -4.36; 95% CI -5.19, -3.5; p<0.00001; I^2=0%) and potassium bicarbonate supplements (SMD -7.62; 95% CI -14.97; -0.26; p=0.04) reduced excretion of the bone resorption marker, urinary cross-linked N-telopeptide of type 1 collagen (NTX).

51. Studies on potassium chloride have reported either a small or no effect on markers of bone health (Frassetto et al., 2000; He et al., 2010) so it is unclear whether the effects reported in the meta-analysis by Lambert et al. (2015) were due to potassium or the conjugate anion. Importantly, evidence from this meta-analysis cannot be used to predict a beneficial effect on bone density or fracture risk.

Individual studies comparing the effects of different potassium salts

52. A small number of individual studies were identified which directly compared the effect on blood pressure of a non-chloride salt of potassium with potassium chloride (see Annex 4).

53. In a small crossover study (n=14), He et al. (2005) reported that potassium chloride and potassium citrate both reduced blood pressure in individuals with hypertension; a similar result was reported by Braschi & Naismith (2008) in participants predominantly without hypertension (n=127). In contrast, Overlack et al. (1995) reported that only potassium citrate significantly reduced blood pressure in individuals with hypertension (n=25) with no significant effect of potassium chloride. A small trial in adults without hypertension (n=24) reported no significant effect of potassium chloride or potassium citrate on blood pressure (Mullen & O'Connor, 1990). He et al. (2010) also reported no effect of potassium bicarbonate or potassium chloride on the blood pressure of individuals with mildly raised blood pressure (n=46).

Combined effect of increased potassium and decreased sodium on blood pressure

54. A number of reviews have hypothesised that the combined effect of increasing potassium and reducing sodium intakes on blood pressure reduction may be greater than the individual effect of either sodium or potassium alone. This issue was also addressed by the European Food Safety Authority (EFSA) in its draft report, *Dietary Reference Values for Potassium* (EFSA, 2016). EFSA concluded that the influence of the sodium-to-potassium intake ratio needed further investigation.

55. A systematic review by Perez & Chang (2014) identified 17 trials that investigated the sodium-to-potassium intake ratio in participants with and without hypertension.

[7] Standardised mean difference.

Seven trials involved food manipulation to alter dietary potassium and/or sodium so were not assessed here. Of the remaining 10 trials, 6 were in participants with hypertension, 3 in participants without hypertension and 1 in participants with mixed hypertension status. Three of the 10 trials did not consider the potassium and sodium intake ratio versus either a reduction in sodium or increase in potassium alone (Zoccali et al., 1985; Richards et al., 1984; Bompiani et al., 1988). Three trials reported a greater reduction in SBP and/or DBP with a combination of reduced sodium intake and increased potassium intake compared with either an increase in potassium intake or decrease in sodium intake (Grobbee et al., 1987; Fujita & Ando, 1984; Parfrey et al., 1981). Two of these trials were in participants with hypertension and one was in participants without hypertension (Parfrey et al., 1981); however, in the Parfrey et al. (1981) trial this result was only seen in participants without hypertension but with a family history of hypertension. Four trials reported no difference in effect (Skrabal et al., 1981; Burstyn et al., 1980; Smith et al., 1985; Skrabal et al., 1984).

56. Most of the included trials had very small sample sizes (n=12 to n=60) and only measured the short term effect of sodium and/or potassium interventions on blood pressure. Additionally, there were differences in the dosage of supplements, 24-hour urinary excretion data were not reported in all trials and some did not report whether participants were blinded or had been randomised. A table of study characteristics for the 10 individual trials that used supplements rather than food-based interventions is included in Annex 5.

57. A meta-analysis by Binia et al. (2015), which included 15 RCTs of potassium supplementation, investigated the relationship between the sodium-to-potassium intake ratio and blood pressure through meta-regression analysis. The authors reported that a decreased sodium-to-potassium intake ratio was associated with blood pressure reduction; every unit of reduction of the sodium to potassium intake ratio was associated with a decrease in SBP of 2.1 mm Hg (95% CI 0.1-4.1; p=0.035).

58. Although there is some evidence to suggest that there may be a synergistic effect of decreased sodium intake and increased potassium intake on blood pressure reduction, overall the existing trials include a number of limitations (see paragraph 61) and the findings between the different trials are heterogeneous. At present, in line with the conclusions drawn by EFSA, there is insufficient evidence on which to draw recommendations and further research is required in this area.

Hypokalaemia

59. There is very limited evidence on the prevalence of hypokalaemia (low serum potassium[8]) in the general population. Figures reported from individual studies range from 1% in healthy adults (Weiner & Wingo, 1997) to 2.7% in an older community-based population (Liamis et al., 2013). No evidence was identified to suggest that low

[8] Defined as a serum potassium concentration of less than 3.5 mmol/L.

dietary potassium intake is a cause of hypokalaemia. Most cases of hypokalaemia occur in the context of specific disease states and therefore in people under medical supervision. People at high risk include patients on diuretic medications and those with diseases that alter renal potassium conservation (Weiner & Wingo, 1997).

60. No evidence was identified to support the hypothesis that increasing the potassium intake of the general population would significantly benefit people with hypokalaemia; however, no adverse effect would be anticipated in such individuals or those in the general, healthy population.

Limitations of assessed evidence

61. Some of the RCTs included in the meta-analyses had very short durations (as little as 4 days). The heterogeneity was high in all the meta-analyses, indicating considerable variability across studies. Not all of the meta-analyses had taken account of sodium intake/excretion and how potassium supplements may have affected this.

62. The evidence for a beneficial association between increased potassium intake and stroke risk comes from meta-analyses of prospective cohort studies which have a number of limitations. The most important considerations are the inadequacy of dietary assessment methods to obtain reliable estimates of potassium intake and confounding by other dietary and lifestyle factors associated with reduced stroke risk. There are strong correlations between potassium, calcium, magnesium and fibre, which are found in a wide range of fruit and vegetables; fruit and vegetable intake has consistently been associated with beneficial effects on blood pressure reduction and CVD risk.

63. There is a lack of data investigating the effect of potassium on blood pressure in children, as only 1 meta-analysis was identified.

64. No evidence was identified that specifically assessed the effect of potassium-based sodium replacers in foods on any health outcome. There is also very little evidence of the effect of potassium salts other than potassium chloride, such as potassium citrate and potassium bicarbonate, on health outcomes. Therefore, it is unclear whether potassium-based sodium replacers in foods would have the same effects as those of potassium supplements.

7) Modelling potential potassium intakes by the UK population

65. The FSA carried out a modelling exercise to explore the potential impact on the UK population of potassium intakes resulting from the use of potassium-based sodium replacers in foods (SACN/COT, 2017).

66. Assumptions on which the modelling was based are set out in detail in the FSA's paper. In relation to the level of sodium substitution, the assumption was for 25% substitution in most food groups and up to 15% substitution in bread. These levels

were chosen as they were considered to represent the maximum likely replacement of added sodium into processed foods in the UK.

67. The modelling predicts that potassium intakes would increase by around 8–15 mmol/day (300–600 mg/day) for different UK population age groups (Table 2 in FSA modelling paper). The average potassium supplementation dose in the meta-analyses assessing the effect of increased potassium intake on blood pressure was 64 mmol/day (2500 mg/day). In studies on stroke, reduced incidence of stroke was reported on the basis of increases in potassium intake of 42 mmol/day (1640 mg/day) and 26 mmol/day (1000 mg/day) (D'Elia et al., 2011; Larsson et al., 2011).

68. The potential increase in potassium intake resulting from the use of potassium-based sodium replacers in the UK diet would appear to be smaller than the increases reported in studies, even if substitution levels of 25% and 15% were implemented in all eligible products by food manufacturers. The magnitude of the effects on blood pressure and risk of stroke is, therefore, likely to be less than reported in studies.

8) Summary

Background and evidence considered

69. In 2013, the Department of Health asked SACN to provide advice on the potential risks and benefits of reducing the salt (sodium) content of foods through the use of potassium-based sodium replacers. This position statement provides a summary of the potential benefits of increasing potassium intakes. SACN asked COT to assess the potential risks of using potassium based sodium replacers. COT's assessment of the potential risks is provided in a separate position statement. The separate assessments of SACN and COT have been integrated into a joint position statement[9] to advise government on the balance of the totality of benefits and risks of increased potassium intake and concomitant reduced sodium intakes for the UK population.

70. The evidence for potential benefits of potassium intake on blood pressure reduction and bone health is primarily provided by systematic reviews and meta-analyses of RCTs of potassium supplementation. The evidence for an association between CVD risk and potassium intake is provided by systematic reviews and meta-analyses of prospective cohort studies.

71. Evidence from RCTs that increased potassium intake through dietary sources (fruit and vegetables) as the intervention was not considered unless the RCT was included in meta-analyses that predominantly assessed the effects of potassium supplementation. The majority of the trials included in the meta-analyses on blood pressure used potassium chloride as the form of potassium supplementation in the intervention, while the meta-analysis assessing the effect of potassium intake on bone

[9] https://www.gov.uk/government/collections/sacn-reports-and-position-statements#position-statements

health used potassium bicarbonate and potassium citrate supplements. The evidence on potassium and CVD is limited to prospective cohort studies that assessed dietary potassium intakes.

Blood pressure

72. Overall, meta-analyses of RCTs in adults have reported significant beneficial effects on reduction of systolic and diastolic blood pressure in participants with hypertension; only 1 meta-analysis reported no effect (Dickinson et al., 2006). There is limited evidence for potassium having a blood pressure lowering effect in adults without hypertension.

73. There is limited evidence from RCTs to suggest that increasing potassium in conjunction with decreasing sodium intakes has a beneficial effect on blood pressure reduction.

74. The results of 1 meta-analysis indicate no effect of potassium supplements on blood pressure in children.

Cardiovascular disease

75. There is consistent evidence from meta-analyses of prospective cohort studies that a higher intake of dietary potassium is associated with a reduced risk of stroke. There is limited evidence that potassium intake has a beneficial effect on total CVD risk. However, these findings should be interpreted with caution since they are based on observational data which have a number of inherent limitations including inaccurate estimations of dietary intake and residual confounding.

Bone health

76. One meta-analysis of RCTs and metabolic studies in adults indicates that potassium bicarbonate and potassium citrate supplements significantly reduce urinary calcium excretion, urinary acid excretion and excretion of a bone resorption marker (NTX). However, it is unclear whether the effect is due to the potassium cation or the conjugate anions.

Conclusion

77. Overall, evidence suggests a beneficial effect of increased potassium intake on blood pressure in participants with hypertension. In addition, it is possible, that a decrease in sodium intake may lead to, or contribute to, a decrease in blood pressure independently of any increase in potassium intake. This possibility was not examined in the evidence considered here.

78. Overall, the evidence suggests a higher potassium intake is associated with a lower risk of stroke incidence.

79. There is limited evidence for a beneficial effect of potassium supplementation on indicators of bone health but it is unclear whether the effect is due to the potassium cation or the conjugate anions.

80. Findings from a modelling exercise indicate that the increase in potassium intake resulting from the use of potassium-based sodium replacers in foods would be smaller than the potassium intakes on which studies based their assessments, even if substitution levels of 25% and 15% were implemented by food manufacturers. Therefore, the magnitude of the effects on blood pressure and risk of stroke are likely to be less than those reported in studies.

9) Research recommendations

81. Further evidence is required on how sodium and potassium balance is affected by:

- low physiological exposure to sodium (i.e. between 100 mmol/day (2300 mg/day) and approx. 40 mmol/day (930mg/day);
- high physiological exposure to sodium and/ or potassium intakes below the current RNI.

82. Evidence is required on the effect of potassium-based sodium replacers in foods on health outcomes (including but not limited to blood pressure, cardiovascular health and markers of musculoskeletal health) both in the short-term (< 3 months) and long-term (> 12 months).

83. Further research is needed on both increased dietary potassium intake and potassium supplementation on a range of health outcomes and in different age groups; in particular, the impact of different potassium salts such as potassium citrate or potassium bicarbonate.

84. Additional health impact modelling is required, particularly for different population groups including ethnic minorities and in the ageing population. Monitoring and evaluation of population diet and health with respect to the use of potassium-based sodium replacers.

85. Additional monitoring is required, particularly in relation to:

- the level of substitution of potassium for sodium in foods, and the types of food(s) in which substitution is used;
- potassium intakes from manufactured and ‘naturally occurring’ sources in the population, stratified by sodium intakes.

Annex 1. National Diet and Nutrition Survey

UK

Table 1: Average daily intake of potassium from food sources only (excluding dietary supplements) as a percentage of Reference Nutrient Intake (RNI), by age and sex

Aged 1.5 years and over *2012/13-2014/15*

Mineral		**Sex and age group (years)**												
		Boys		**Men**		**Girls**		**Women**		**Total**				
		4-10	11-18	19-64	65+	4-10	11-18	19-64	65+	1.5-3	4-10	11-18	19-64	65+
		%	%	%	%	%	%	%	%	%	%	%	%	%
Potassium	Mean	149	77	88	84	140	65	73	74	222	144	71	81	79
	Median	136	75	86	82	131	66	71	74	212	135	71	79	79
	SD	52	24	27	22	52	19	22	22	67	52	23	26	22
Bases (unweighted)		*258*	*268*	*373*	*130*	*237*	*280*	*592*	*193*	*215*	*495*	*548*	*965*	*323*

National diet and Nutrition Survey. Headline results from Years 5 and 6 (combined) of the Rolling Programme (2012/13 – 2014/15)

Table 2: Average daily intake of potassium from all sources (including dietary supplements) as a percentage of Reference Nutrient Intake (RNI), by age and sex

Aged 1.5 years and over ***2012/13-2014/15***

Mineral		**Sex and age group (years)**												
		Boys		**Men**		**Girls**		**Women**		**Total**				
		4-10	11-18	19-64	65+	4-10	11-18	19-64	65+	1.5-3	4-10	11-18	19-64	65+
		%	%	%	%	%	%	%	%	%	%	%	%	%
Potassium	Mean	150	77	88	84	140	65	73	74	222	144	71	81	79
	Median	136	75	86	82	131	66	71	74	212	135	71	79	79
	SD	52	24	27	22	52	19	22	22	67	52	23	26	22
Bases (unweighted)		*258*	*268*	*373*	*130*	*237*	*280*	*592*	*193*	*215*	*495*	*548*	*965*	*323*

National Diet and Nutrition Survey. Headline results from Years 5 and 6 (combined) of the Rolling Programme (2012/2013 – 2014/15)

Table 3: Proportion of participants with average daily intakes of potassium , from food sources only (excluding dietary supplements), below the Lower Reference Nutrient Intake (LRNI), by age and sex

Aged 1.5 years and over *2012/13-2014/15*

Mineral	**Sex and age group (years)**												
	Boys		**Men**		**Girls**		**Women**		**Total**				
	4-10	11-18	19-64	65+	4-10	11-18	19-64	65+	1.5-3	4-10	11-18	19-64	65+
	%	%	%	%	%	%	%	%	%	%	%	%	%
Potassium	0	15	11	9	0	33	26	24	0	0	24	18	17
Bases (unweighted)	*258*	*268*	*373*	*130*	*237*	*280*	*592*	*193*	*215*	*495*	*548*	*965*	*323*

National Diet and Nutrition Survey. Headline results from Years 5 and 6 (combined) of the Rolling Programme (2012/2013 – 2014/15)

Table 4: Proportion of participants with average daily intakes of potassium, from all sources (including dietary supplements), below the Lower Reference Nutrient Intake (LRNI), by age and sex

Aged 1.5 years and over ***2012/13-2014/15***

Mineral	**Sex and age group (years)**												
	Boys		**Men**		**Girls**		**Women**		**Total**				
	4-10	11-18	19-64	65+	4-10	11-18	19-64	65+	1.5-3	4-10	11-18	19-64	65+
	%	%	%	%	%	%	%	%	%	%	%	%	%
Potassium	0	16	11	9	0	33	26	24	0	0	24	18	17
Bases (unweighted)	*258*	*268*	*373*	*130*	*237*	*280*	*592*	*193*	*215*	*495*	*548*	*965*	*323*

National Diet and Nutrition Survey. Headline results from Years 5 and 6 (combined) of the Rolling Programme (2012/2013 – 2014/15)

Table 5: Percentage contribution of food groups to average daily potassium intake (mg), by sex and age

Aged 1.5 years and over ***2012/13-2014/15***

Food group[a]	Sex and age group (years)														
	Boys		**Total boys**	**Men**		**Girls**		**Total girls**	**Women**		**Total**				
	4-10	11-18		19-64	65+	4-10	11-18		19-64	65+	1.5-3	4-10	11-18	19-64	65+
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Cereals and cereal products	18	18	18	16	15	17	19	18	14	15	14	17	18	15	15
of which:															
Pasta, rice, pizza and other miscellaneous cereals	4	5	5	4	1	4	6	5	3	1	3	4	5	4	1
White bread	3	4	3	3	2	3	3	3	2	2	2	3	4	3	2
Wholemeal bread	1	1	1	1	2	1	1	1	1	2	1	1	1	1	2
Brown, granary and wheatgerm bread	2	2	2	2	2	1	1	1	1	1	1	2	2	1	1
High fibre breakfast cereals	3	2	2	2	4	2	1	2	2	4	3	3	2	2	4
Other breakfast cereals	1	1	1	0	0	1	1	1	0	0	1	1	1	0	0
Biscuits	2	2	2	1	1	2	2	2	1	1	2	2	2	1	1
Buns, cakes, pastries and fruit pies	2	2	2	1	2	2	2	2	1	2	1	2	2	1	2
Puddings	1	0	1	0	1	1	1	1	0	1	1	1	1	0	1
Milk and milk products	20	14	17	11	12	21	12	16	12	14	32	20	13	11	13
of which:															
Whole milk (3.8% fat)	6	2	4	1	1	6	2	4	1	1	15	6	2	1	1
Semi skimmed milk (1.8% fat)	7	7	7	5	6	8	5	6	5	7	7	8	6	5	7
Skimmed milk (0.5% fat)	0	1	1	1	1	0	0	0	1	1	0	0	0	1	1
Other milk and cream	2	1	1	1	1	2	1	2	1	1	3	2	1	1	1
Cheese	0	0	0	0	0	1	0	0	1	0	1	0	0	1	0
Other cheese	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yoghurt, fromage frais and other dairy desserts	3	2	2	2	2	3	2	3	2	3	5	3	2	2	2
Ice cream	1	1	1	0	1	1	1	1	0	0	1	1	1	0	1
Eggs and egg dishes	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Food group[a]	Sex and age group (years)														
	Boys		**Total boys**	**Men**		**Girls**		**Total girls**	**Women**		**Total**				
	4-10	11-18		19-64	65+	4-10	11-18		19-64	65+	1.5-3	4-10	11-18	19-64	65+
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Fat spreads[b]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meat and meat products	13	19	16	18	17	13	17	15	15	13	10	13	18	17	15
of which:															
Bacon and ham	2	2	2	2	2	1	2	1	1	2	1	1	2	2	2
Beef, veal and dishes	3	4	4	4	4	2	4	3	3	3	2	3	4	4	3
Lamb and dishes	0	1	1	1	1	0	1	1	1	1	1	0	1	1	1
Pork and dishes	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Coated chicken and turkey	1	2	2	1	0	1	2	2	1	0	2	1	2	1	0
Chicken, turkey and dishes	4	6	5	5	4	5	5	5	6	4	2	4	5	6	4
Burgers and kebabs	1	1	1	1	0	1	1	1	0	0	0	1	1	1	0
Sausages	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Meat pies and pastries	0	1	0	1	1	0	1	1	0	1	0	0	1	1	1
Other meat, meat products and dishes	0	0	0	1	0						0	0	0	0	0
Fish and fish dishes	2	2	2	3	4	2	2	2	3	4	2	2	2	3	4
of which:															
White fish coated or fried including fish fingers	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
Other white fish, shellfish or fish dishes and canned tuna	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Oily fish	0	1	1	1	2	0	1	0	1	2	1	0	1	1	2
Vegetables and potatoes	20	22	21	23	24	21	25	23	25	24	13	21	24	24	24
of which:															
Salad and other raw vegetables	2	2	2	2	2	2	2	2	4	3	1	2	2	3	3
Vegetables (not raw) including vegetable dishes	5	5	5	7	7	5	6	6	8	8	4	5	6	7	7
Chips, fried and roast potatoes and potato products	8	11	9	9	7	9	11	10	7	5	4	9	11	8	6

Food group[a]	Sex and age group (years)														
	Boys		Total boys	Men		Girls		Total girls	Women		Total				
	4-10	11-18		19-64	65+	4-10	11-18		19-64	65+	1.5-3	4-10	11-18	19-64	65+
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Other potatoes, potato salads and dishes	5	5	5	6	8	5	6	5	6	8	4	5	5	6	8
Savoury snacks	4	5	4	3	1	5	5	5	2	1	2	4	5	2	1
Nuts and seeds	1	0	0	1	0	0	0	0	1	1	0	0	0	1	0
Fruit	11	4	7	6	8	9	5	7	8	10	13	10	5	7	9
Sugar, preserves and confectionery	2	2	2	2	1	2	2	2	1	1	1	2	2	1	1
of which:															
Chocolate confectionery	1	2	2	1	0	2	2	2	1	1	1	1	2	1	1
Non-alcoholic beverages[c]	7	8	8	8	9	6	7	7	10	8	7	7	8	9	9
of which:															
Fruit juice	5	5	5	2	2	4	5	4	3	2	4	5	5	2	2
Soft drinks, not low calorie	1	1	1	0	0	1	1	1	0	0	1	1	1	0	0
Soft drinks, low calorie	1	1	1	0	0	1	1	1	0	0	2	1	1	0	0
Tea, coffee and water	0	1	0	5	7	0	1	1	6	7	0	0	1	6	7
Alcoholic beverages	0	0	0	6	5	0	0	0	3	1	0	0	0	4	3
of which:															
Wine	0	0	0	1	1	0	0	0	2	1	0	0	0	1	1
Beer, lager, cider and perry	0	0	0	5	4	0	0	0	1	0	0	0	0	3	2
Miscellaneous[d]	3	3	3	3	3	3	4	3	4	4	4	3	4	4	4
of which:															
Dry weight beverages	0	0	0	0	1	0	0	0	1	1	0	0	0	0	1
Soup, manufactured/retail and homemade	1	1	1	1	2	1	1	1	2	2	1	1	1	2	2
Savoury sauces, pickles, gravies and condiments	2	2	2	2	1	1	3	2	2	1	1	2	2	2	1
Commercial toddler foods											1	0	0	0	0

Food group[a]	Sex and age group (years)														
	Boys		Total boys	Men		Girls		Total girls	Women		Total				
	4-10	11-18		19-64	65+	4-10	11-18		19-64	65+	1.5-3	4-10	11-18	19-64	65+
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Average daily potassium intake mg	2200	2553	2389	3095	2946	2027	2153	2094	2548	2601	1774	2115	2358	2820	2755
Bases (unweighted)	*258*	*268*	*526*	*373*	*130*	237	280	517	592	193	*215*	*495*	*548*	*965*	*323*

[a] Food groups that contribute <0.5% to intake across all age/sex groups are excluded from the table. All other food groups are included.

[b] Some oils which are used as a condiment on bread or salads are included in this food group; however this food group does not include oils or fats used in cooking.

[c] Non-alcoholic beverages are reported as consumed with diluent water.

[d] In addition to dry weight beverages; soup, manufactured/retail and homemade; savoury sauces, pickles, gravies and condiments; and commercial toddler foods, Miscellaneous also includes nutrition powders and drinks.

Scotland

Table 6: Average daily intake of potassium from food sources only (excluding dietary supplements), as a percentage of Reference Nutrient Intake (RNI) in Scotland, by age and sex

Aged 1.5 years and over *2008/09-2011/12*

Mineral		**Sex and age group (years)**														
		Boys		**Total boys**	**Men**		**Girls**		**Total girls**	**Women**		**Total**				
		4-10	11-18		19-64	65+	4-10	11-18		19-64	65+	1.5-3	4-10	11-18	19-64	65+
		%	%		%	%	%	%		%	%	%	%	%	%	%
Potassium	Mean	150	76	109	85	87	137	60	94	69	69	220	144	68	77	76
	Median	138	77	95	81	86	126	59	76	67	69	224	131	65	73	74
	SD	50	21	52	29	26	49	17	52	19	17	52	50	21	25	23
Bases (unweighted)		*163*	*199*	*362*	*273*	*80*	*144*	*197*	*341*	*377*	*137*	*125*	*307*	*396*	*650*	*217*

National Diet and Nutrition Survey. Headline results form Years 1, 2, 3 and 4 (combined) of the Rolling Programme (2008/09-2011/12): Scotland.

Table 7: Average daily intake of potassium from all sources (including dietary supplements) as a percentage of Reference Nutrient Intake (RNI) in Scotland, by sex and age

Aged 1.5 years and over *2008/09-2011/12*

Mineral		**Sex and age group (years)**														
		Boys		**Total boys**	**Men**		**Girls**		**Total girls**	**Women**		**Total**				
		4-10	11-18		19-64	65+	4-10	11-18		19-64	65+	1.5-3	4-10	11-18	19-64	65+
		%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Potassium	Mean	150	76	109	85	87	137	60	94	69	69	220	144	68	77	76
	Median	138	77	95	81	86	126	59	76	67	69	224	131	65	73	74
	SD	50	21	52	29	26	49	17	52	19	17	52	50	21	25	23
Bases (unweighted)		*163*	*199*	*362*	*273*	*80*	*144*	*197*	*341*	*377*	*137*	*125*	*307*	*396*	*650*	*217*

National Diet and Nutrition Survey. Results from Years 1,2,3 and 4 (combined) of the Rolling Programme (2008/2009 – 2011/12): Scotland.

Table 8: Proportion of participants with average daily intakes of potassium from food sources only (excluding dietary supplements) below the Lower Reference Nutrient Intake (LRNI) in Scotland, by sex and age

Aged 1.5 years and over *2008/09-2011/12*

Mineral	Sex and age group (years)														
	Boys		Total boys	Men		Girls		Total girls	Women		Total				
	4-10	11-18		19-64	65+	4-10	11-18		19-64	65+	1-3	4-10	11-18	19-64	65+
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Potassium	0	15	8	14	11	0	41	23	26	27	0	0	27	20	20
Bases (unweighted)	*163*	*199*	*362*	*273*	*80*	*144*	*197*	*341*	*377*	*137*	*125*	*307*	*396*	*650*	*217*

National Diet and Nutrition Survey. Results from Years 1,2,3 and 4 (combined) of the Rolling Programme (2008/2009 – 2011/12): Scotland.

Table 9: Proportion of participants with average daily intakes of potassium from all sources (including dietary supplements) below the Lower Reference Nutrient Intake (LRNI) in Scotland, by sex and age

Aged 1.5 years and over *2008/09-2011/12*

Mineral	Sex and age group (years)														
	Boys		Total boys	Men		Girls		Total girls	Women		Total				
	4-10	11-18		19-64	65+	4-10	11-18		19-64	65+	1-3	4-10	11-18	19-64	65+
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Potassium	0	15	8	14	11	0	41	23	26	27	0	0	27	20	20
Bases (unweighted)	*163*	*199*	*362*	*273*	*80*	*144*	*197*	*341*	*377*	*137*	*125*	*307*	*396*	*650*	*217*

National Diet and Nutrition Survey. Results from Years 1,2,3 and 4 (combined) of the Rolling Programme (2008/2009 – 2011/12): Scotland.

Table 10: Percentage contribution of food groups to average daily potassium intake (mg) in Scotland, by sex and age

Aged 1.5 years and over ***2008/09-2011/12***

Food group[a]	Sex and age group (years)														
	Boys		**Total boys**	**Men**		**Girls**		**Total girls**	**Women**		**Total**				
	4-10	11-18		19-64	65+	4-10	11-18		19-64	65+	1.5-3	4-10	11-18	19-64	65+
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Cereals and cereal products	16	17	16	15	16	16	18	17	14	15	15	16	17	14	15
of which:															
Pasta, rice, pizza and other miscellaneous cereals	4	5	4	4	1	4	6	5	3	1	3	4	5	3	1
White bread	3	4	4	3	3	3	4	4	3	2	3	3	4	3	2
Wholemeal bread	1	1	1	1	1	1	1	1	2	2	2	1	1	1	2
Brown, granary and wheatgerm bread	1	1	1	1	1	1	1	1	1	2	1	1	1	1	2
High fibre breakfast cereals	2	2	2	2	3	2	1	2	2	2	2	2	2	2	3
Other breakfast cereals	1	1	1	0	0	1	1	1	0	0	1	1	1	0	0
Biscuits	2	1	1	1	2	2	2	2	1	2	1	2	1	1	2
Buns, cakes, pastries and fruit pies	1	1	1	1	2	2	2	2	1	2	1	1	1	1	2
Puddings	1	1	1	0	1	1	1	1	0	1	1	1	1	0	1
Milk and milk products	23	16	19	11	10	21	13	17	12	16	29	22	14	12	13
of which:															
Whole milk (3.8% fat)	7	4	5	2	3	6	2	4	1	3	13	6	3	2	3
Semi skimmed milk (1.8% fat)	9	8	8	6	5	8	7	8	6	7	8	9	7	6	6
Skimmed milk (0.5% fat)	0	0	0	1	0	0	0	0	1	1	0	0	0	1	1
Other milk and cream	2	1	2	0	1	1	1	1	0	0	2	2	1	0	0
Cheese	0	0	0	0	0	0	1	0	1	0	1	0	0	1	0
Other cheese	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Yoghurt, fromage frais and other dairy desserts	4	2	3	2	1	3	2	2	2	4	5	4	2	2	3
Ice cream	1	1	1	0	0	1	1	1	0	1	0	1	1	0	0
Eggs and egg dishes	1	1	1	1	2	1	1	1	1	1	1	1	1	1	2
Fat spreads[b]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meat and meat products	12	19	16	20	14	13	17	15	17	14	10	13	18	18	14
of which:															
Bacon and ham	1	2	2	2	2	2	2	2	2	2	1	2	2	2	2

Food group[a]	Sex and age group (years)														
	Boys		Total boys	Men		Girls		Total girls	Women		Total				
	4-10	11-18		19-64	65+	4-10	11-18		19-64	65+	1.5-3	4-10	11-18	19-64	65+
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Beef, veal and dishes	3	4	3	5	4	3	3	3	5	4	2	3	3	5	4
Lamb and dishes	0	1	1	1	2	0	0	0	0	1	0	0	1	1	1
Pork and dishes	0	1	1	1	1	0	0	0	1	0	0	0	1	1	1
Coated chicken and turkey	1	2	1	1	0	2	2	2	1	0	1	2	2	1	0
Chicken, turkey and dishes	3	5	4	6	3	3	7	5	6	4	2	3	6	6	4
Burgers and kebabs	1	1	1	1	0	0	1	1	0	0	0	1	1	1	0
Sausages	2	2	2	2	1	1	1	1	1	1	1	2	2	1	1
Meat pies and pastries	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1
Other meat, meat products and dishes	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1
Fish and fish dishes	3	2	2	3	5	2	2	2	4	5	2	2	2	3	5
of which:															
White fish coated or fried including fish fingers	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1
Other white fish, shellfish, fish dishes and canned tuna	1	1	1	1	2	1	1	1	2	2	1	1	1	1	2
Oily fish	0	0	0	1	1	0	1	0	1	2	0	0	0	1	1
Vegetables and potatoes	18	23	21	22	24	19	22	21	23	21	13	18	23	23	22
of which:															
Salad and other raw vegetables	1	1	1	2	3	1	2	2	4	3	1	1	1	3	3
Vegetables (not raw) including vegetable dishes	4	4	4	5	5	4	3	4	5	5	4	4	4	5	5
Chips, fried and roast potatoes and potato products	8	13	11	9	7	9	12	10	7	4	5	9	12	8	5
Other potatoes, potato salads and dishes	4	6	5	6	9	5	5	5	7	8	3	5	6	7	9
Savoury snacks	4	5	4	3	1	5	5	5	2	1	2	4	5	3	1
Nuts and seeds	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fruit	10	5	7	6	10	10	6	8	8	11	15	10	5	7	10
Sugar, preserves and confectionery	2	2	2	1	1	2	2	2	1	1	2	2	2	1	1
of which:															
Chocolate confectionery	2	2	2	1	1	2	2	2	1	1	1	2	2	1	1
Non-alcoholic beverages[c]	8	6	7	7	8	8	8	8	9	10	7	8	7	8	9
of which:															
Fruit juice	6	4	5	2	3	6	5	5	2	2	4	6	4	2	2

Food group[a]	Sex and age group (years)														
	Boys		Total boys	Men		Girls		Total girls	Women		Total				
	4-10	11-18		19-64	65+	4-10	11-18		19-64	65+	1.5-3	4-10	11-18	19-64	65+
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Soft drinks, not low calorie	1	1	1	0	0	1	1	1	0	0	1	1	1	0	0
Soft drinks, low calorie	1	1	1	0	0	1	0	1	0	0	2	1	0	0	0
Tea, coffee and water	0	1	0	4	6	0	1	1	6	7	0	0	1	5	7
Alcoholic beverages	0	1	1	6	3	0	0	0	3	1	0	0	1	4	2
of which:															
Wine	0	0	0	1	2	0	0	0	2	1	0	0	0	2	1
Beer, lager, cider and perry	0	1	0	5	2	0	0	0	1	0	0	0	1	3	1
Miscellaneous[d]	3	4	3	4	5	3	5	4	5	5	4	3	4	5	5
Dry weight beverages	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Soup, manufactured/retail and homemade	1	2	2	2	4	2	3	2	3	4	2	1	2	3	4
Savoury sauces, pickles, gravies and condiments	1	2	1	2	1	1	2	2	1	0	1	1	2	1	1
Commercial toddler foods	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Average daily total potassium intake mg	2250	2525	2405	2964	3031	2070	1980	2019	2410	2408	1760	2162	2259	2682	2673
Bases (unweighted)	*163*	*199*	*362*	*273*	*80*	*144*	*197*	*341*	*377*	*137*	*125*	*307*	*396*	*650*	*217*

[a] Food groups that contribute <0.5% to intake across all age/sex groups are excluded from the table. All other food groups are included.

[b] Some oils which are used as a condiment on bread or salads are included in this food group; however this food group does not include oils or fats used in cooking.

[c] Non-alcoholic beverages are reported as consumed with diluent water.

[d] In addition to dry weight beverages; soup, manufactured/retail and homemade; savoury sauces, pickles, gravies and condiments; and commercial toddler foods, Miscellaneous also includes nutrition powders and drinks.

National Diet and Nutrition Survey. Results from Years 1,2,3 and 4 (combined) of the Rolling Programme (2008/2009 – 2011/12): Scotland.

Northern Ireland

Table 11: Average daily intake of potassium from food sources only (excluding dietary supplements) as a percentage of Reference Nutrient Intake (RNI) in Northern Ireland, by sex and age

Aged 1.5 years and over — *2008/09-2011/12*

Mineral		Sex and age group (years)[a]												
		Boys		**Total boys**	**Men**	**Girls**		**Total girls**	**Women**	**Total**				
		4-10	11-18		19-64	4-10	11-18		19-64	1.5-3	4-10	11-18	19-64	65+
		%	%	%	%	%	%	%	%	%	%	%	%	%
Potassium	Mean	148	77	109	83	143	63	99	69	219	146	71	76	77
	Median	134	78	92	81	123	60	80	69	206	133	70	75	75
	SD	52	20	52	24	59	19	58	18	62	55	20	22	20
Bases (unweighted)		*94*	*120*	*214*	*145*	*88*	*116*	*204*	*246*	*94*	*182*	*236*	*391*	*79*

[a] Due to small cell sizes, participants aged 65 years and over have only been reported as males and females combined.

National Diet and Nutrition Survey. Results from Years 1,2,3 and 4 (combined) of the Rolling Programme (2008/2009 – 2011/12): Northern Ireland.

Table 12: Average daily intake of potassium from all sources (including dietary supplements) as a percentage of Reference Nutrient Intake (RNI) in Northern Ireland, by sex and age

Aged 1.5 years and above — ***2008/09-2011/12***

Mineral		Sex and age group (years)[a]												
		Boys		**Total boys**	**Men**	**Girls**		**Total girls**	**Women**	**Total**				
		4-10	11-18		19-64	4-10	11-18		19-64	1.5-3	4-10	11-18	19-64	65+
		%	%	%	%	%	%	%	%	%	%	%	%	%
Potassium	Mean	148	77	109	83	143	63	99	69	219	146	71	76	77
	Median	134	78	92	81	123	60	80	69	206	134	70	75	75
	SD	52	20	51	24	59	19	58	18	62	55	20	22	20
Bases (unweighted)		*94*	*120*	*214*	*145*	*88*	*116*	*204*	*246*	*94*	*182*	*236*	*391*	*79*

[a] Due to small cell sizes, participants aged 65 years and over have only been reported as males and females combined.

National Diet and Nutrition Survey. Results from Years 1,2,3 and 4 (combined) of the Rolling Programme (2008/2009 – 2011/12): Northern Ireland.

Table 13: Proportion of participants with average daily intakes of potassium from food sources only (excluding dietary supplements) below the Lower Reference Nutrient Intake (LRNI) in Northern Ireland, by sex and age

Aged 1.5 years and above *2008/09-2011/12*

Mineral	Sex and age group (years)[a]												
	Boys		Total boys	Men	Girls		Total girls	Women	Total				
	4-10	11-18		19-64	4-10	11-18		19-64	1-3	4-10	11-18	19-64	65+
	%	%	%	%	%	%	%	%	%	%	%	%	%
Potassium	0	12	7	13	2	36	21	24	0	1	24	19	15
Bases (unweighted)	*94*	*120*	*214*	*145*	*88*	*116*	*204*	*246*	*94*	*182*	*236*	*391*	*79*

[a] Due to small cell sizes, participants aged 65 years and over have only been reported as males and females combined.

National Diet and Nutrition Survey. Results from Years 1,2,3 and 4 (combined) of the Rolling Programme (2008/2009 – 2011/12): Northern Ireland.

Table 14: Proportion of participants with average daily intakes of potassium from all sources (including dietary supplements) below the Lower Reference Nutrient Intake (LRNI) in Northern Ireland, by sex and age

Aged 1.5 years and over *2008/09 - 2011/12*

Mineral	Sex and age group (years)[a]												
	Boys		Total boys	Men	Girls		Total girls	Women	Total				
	4-10	11-18		19-64	4-10	11-18		19-64	1-3	4-10	11-18	19-64	65+
	%	%	%	%	%	%	%	%	%	%	%	%	%
Potassium	0	12	7	13	2	36	21	24	0	1	24	19	15
Bases (unweighted)	*94*	*120*	*214*	*145*	*88*	*116*	*204*	*246*	*94*	*182*	*236*	*391*	*79*

[a] Due to small cell sizes, participants aged 65 years and over have only been reported as males and females combined.

National Diet and Nutrition Survey. Results from Years 1,2,3 and 4 (combined) of the Rolling Programme (2008/2009 – 2011/12): Northern Ireland.

Table 15: Percentage contribution of food groups to average daily potassium intake (mg) in Northern Ireland, by sex and age

Aged 1.5 years and over ***2008/09 - 2011/12***

Food group[a]	Sex and age group (years)[b]												
	Boys		**Total boys**	**Men**	**Girls**		**Total girls**	**Women**	**Total**				
	4-10	11-18		19-64	4-10	11-18		19-64	1.5-3	4-10	11-18	19-64	65+
	%	%	%	%	%	%	%	%	%	%	%	%	%
Cereals and cereal products	16	17	16	14	16	15	16	15	17	16	16	15	18
of which:													
Pasta, rice, pizza and other miscellaneous cereals	2	4	3	3	2	4	3	3	3	2	4	3	1
White bread	3	4	4	3	3	4	3	3	3	3	4	3	3
Wholemeal bread	1	1	1	1	1	1	1	2	1	1	1	1	2
Brown, granary and wheatgerm bread	1	1	1	1	1	1	1	1	1	1	1	1	2
High fibre breakfast cereals	2	2	2	2	2	1	2	2	3	2	2	2	3
Other breakfast cereals	1	1	1	0	1	1	1	0	1	1	1	0	0
Biscuits	2	1	2	1	2	1	2	2	1	2	1	2	1
Buns, cakes, pastries and fruit pies	2	1	2	1	2	1	2	1	1	2	1	1	3
Puddings	1	1	1	0	1	0	1	1	1	1	1	0	1
Milk and milk products	24	17	20	13	21	14	17	12	30	23	16	12	16
of which:													
Whole milk (3.8% fat)	6	4	5	2	5	1	3	1	12	6	3	2	3
Semi skimmed milk (1.8% fat)	11	9	10	7	10	9	9	7	11	10	9	7	9
Skimmed milk (0.5% fat)	0	0	0	0	0	0	0	0	0	0	0	0	1
Other milk and cream	1	1	1	0	1	1	1	0	1	1	1	0	0
Cheese	0	0	0	1	0	0	0	0	0	0	0	1	0
Yoghurt, fromage frais and other dairy desserts	5	2	3	1	4	1	2	3	5	4	1	2	3
Ice cream	1	1	1	0	1	1	1	0	1	1	1	0	0
Eggs and egg dishes	0	1	0	1	0	1	0	1	1	0	1	1	1
Fat spreads[c]	0	0	0	0	0	0	0	0	0	0	0	0	0
Meat and meat products	16	20	18	21	15	18	17	19	10	15	19	20	14
of which:													
Bacon and ham	2	3	2	2	2	2	2	2	1	2	2	2	2
Beef, veal and dishes	4	4	4	6	3	4	4	5	3	4	4	5	4
Lamb and dishes	0	0	0	1	1	0	0	0	0	0	0	1	1

Food group[a]	Sex and age group (years)[b]												
	Boys		Total boys	Men	Girls		Total girls	Women	Total				
	4-10	11-18		19-64	4-10	11-18		19-64	1.5-3	4-10	11-18	19-64	65+
	%	%	%	%	%	%	%	%	%	%	%	%	%
Pork and dishes	1	1	1	1	1	1	1	1	0	1	1	1	1
Coated chicken and turkey	2	2	2	1	2	2	2	1	1	2	2	1	0
Chicken, turkey and dishes	4	5	5	5	4	6	5	7	2	4	6	6	4
Burgers and kebabs	1	1	1	1	1	1	1	1	0	1	1	1	0
Sausages	2	2	2	2	1	1	1	1	2	1	2	1	1
Meat pies and pastries	1	1	1	1	0	1	1	1	0	1	1	1	0
Fish and fish dishes	1	1	1	2	1	2	2	2	2	1	1	2	5
of which:													
White fish coated or fried including fish fingers	1	1	1	1	1	1	1	1	2	1	1	1	1
Other white fish, shellfish, fish dishes and canned tuna	0	1	0	1	0	1	0	1	0	0	1	1	2
Oily fish	0	0	0	0	0	0	0	1	0	0	0	0	1
Vegetables and potatoes	19	25	22	25	21	27	24	25	15	20	26	25	24
of which:													
Salad and other raw vegetables	0	0	0	2	1	1	1	3	0	1	1	2	3
Vegetables (not raw) including vegetable dishes	4	4	4	5	4	4	4	7	5	4	4	6	5
Chips, fried and roast potatoes and potato products	10	14	12	11	11	15	13	8	6	10	14	9	5
Other potatoes, potato salads and dishes	6	7	6	7	5	7	6	8	4	5	7	7	11
Savoury snacks	4	4	4	3	4	5	4	2	2	4	4	2	0
Nuts and seeds	0	0	0	1	0	0	0	1	0	0	0	1	0
Fruit	8	3	6	5	9	6	7	8	12	9	4	6	8
Sugar, preserves and confectionery	2	2	2	1	2	2	2	2	2	2	2	1	1
of which:													
Chocolate confectionery	2	2	2	1	2	2	2	1	1	2	2	1	0
Non-alcoholic beverages[d]	7	6	6	6	6	6	6	8	6	7	6	7	8
of which:													
Fruit juice	4	3	4	1	4	3	4	2	4	4	3	2	2
Soft drinks, not low calorie	1	1	1	1	1	1	1	0	1	1	1	1	0
Soft drinks, low calorie	1	0	1	0	1	0	1	0	1	1	0	0	0
Tea, coffee and water	0	1	1	4	0	1	1	6	0	0	1	5	6

Food group[a]	Sex and age group (years)[b]												
	Boys		Total boys	Men	Girls		Total girls	Women	Total				
	4-10	11-18		19-64	4-10	11-18		19-64	1.5-3	4-10	11-18	19-64	65+
	%	%	%	%	%	%	%	%	%	%	%	%	%
Alcoholic beverages	0	0	0	6	0	0	0	2	0	0	0	4	1
of which:													
Spirits and liqueurs	0	0	0	0	0	0	0	0	0	0	0	0	0
Wine	0	0	0	1	0	0	0	1	0	0	0	1	0
Beer, lager, cider and perry	0	0	0	5	0	0	0	1	0	0	0	3	1
Miscellaneous[e]	2	4	3	3	3	5	4	4	2	3	4	3	2
Soup, manufactured/retail and homemade	1	1	1	1	1	1	1	1	1	1	1	1	2
Savoury sauces, pickles, gravies and condiments	1	2	2	1	1	3	2	2	1	1	3	2	0
Average daily total potassium intake mg	2237	2543	2406	2909	2095	2105	2101	2423	1751	2168	2330	2665	2704
Bases (unweighted)	*94*	*120*	*214*	*145*	*88*	*116*	*204*	*246*	*94*	*182*	*236*	*391*	*79*

[a] Food groups that contribute <0.5% to intake across all age/sex groups are excluded from the table. All other food groups are included.

[b] Due to small cell sizes, participants aged 65 years and over have only been reported as males and females combined.

[c] Some oils which are used as a condiment on bread or salads are included in this food group; however this food group does not include oils or fats used in cooking.

[d] Non-alcoholic beverages are reported as consumed with diluent water.

[e] In addition to dry weight beverages; soup, manufactured/retail and homemade; savoury sauces, pickles, gravies and condiments; and commercial toddler foods, Miscellaneous also includes nutrition powders and drinks.

National Diet and Nutrition Survey. Results from Years 1,2,3 and 4 (combined) of the Rolling Programme (2008/2009 – 2011/12): Northern Ireland.

Wales

Table 16: Average daily intake of potassium from food sources only (excluding dietary supplements) as a percentage of Reference Nutrient Intake (RNI) in Wales, by sex and age

Aged 1.5 years and over *2009/10-2012/13*

Mineral		**Sex and age group (years)**														
		Boys		**Total boys**	**Men**		**Girls**		**Total girls**	**Women**		**Total**				
		4-10	11-18		19-64	65+	4-10	11-18		19-64	65+	1.5-3	4-10	11-18	19-64	65+
		%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Potassium	Mean	152	75	109	83	77	135	62	94	73	73	233	144	69	78	75
	Median	142	73	95	83	72	127	60	78	72	72	230	136	66	76	72
	SD	56	21	56	24	24	50	18	51	22	23	55	53	20	24	23
Bases (unweighted)		*83*	*81*	*164*	*130*	*54*	*66*	*94*	*160*	*198*	*79*	*67*	*149*	*175*	*328*	*133*

National Diet and Nutrition Survey. Results from Years 2,3,4 and 5 (combined) of the Rolling Programme (2009/10 – 2012/13): Wales

Table 17: Average daily intake of potassium from all sources (including dietary supplements) as a percentage of Reference Nutrient Intake (RNI) in Wales, by sex and age

Aged 1.5 years and over *2009/10-2012/13*

Mineral		**Sex and age group (years)**														
		Boys		**Total boys**	**Men**		**Girls**		**Total girls**	**Women**		**Total**				
		4-10	11-18		19-64	65+	4-10	11-18		19-64	65+	1.5-3	4-10	11-18	19-64	65+
		%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Potassium	Mean	152	75	109	83	77	135	62	94	73	73	233	144	69	78	75
	Median	142	73	95	83	72	127	60	78	72	72	230	136	66	76	72
	SD	56	21	56	24	24	50	18	51	22	23	55	53	20	24	23
Bases (unweighted)		*83*	*81*	*164*	*130*	*54*	*66*	*94*	*160*	*198*	*79*	*67*	*149*	*175*	*328*	*133*

National Diet and Nutrition Survey. Results from Years 2,3,4 and 5 (combined) of the Rolling Programme (2009/10 – 2012/13): Wales

Table 18: Proportion of participants with average daily intakes of potassium from food sources only (excluding dietary supplements) below the Lower Reference Nutrient Intake (LRNI) in Wales, by sex and age

Aged 1.5 years and over *2009/10-2012/13*

Mineral	Sex and age group (years)														
	Boys		**Total boys**	**Men**		**Girls**		**Total girls**	**Women**		**Total**				
	4-10	11-18		19-64	65+	4-10	11-18		19-64	65+	1.5-3	4-10	11-18	19-64	65+
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Potassium	0	17	10	13	19	0	39	22	24	32	0	0	28	18	26
Bases (unweighted)	*83*	*81*	*164*	*130*	*54*	*66*	*94*	*160*	*198*	*79*	*67*	*149*	*175*	*328*	*133*

National Diet and Nutrition Survey. Results from Years 2,3,4 and 5 (combined) of the Rolling Programme (2009/10 – 2012/13): Wales

Table 19: Proportion of participants with average daily intakes of potassium from all sources (including dietary supplements) below the Lower Reference Nutrient Intake (LRNI) in Wales, by sex and age

Aged 1.5 years and over 2009/10-2012/13

Mineral	Sex and age group (years)														
	Boys		**Total boys**	**Men**		**Girls**		**Total girls**	**Women**		**Total**				
	4-10	11-18		19-64	65+	4-10	11-18		19-64	65+	1.5-3	4-10	11-18	19-64	65+
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Potassium	0	17	10	13	19	0	39	22	24	32	0	0	28	18	26
Bases (unweighted)	*83*	*81*	*164*	*130*	*54*	*66*	*94*	*160*	*198*	*79*	*67*	*149*	*175*	*328*	*133*

National Diet and Nutrition Survey. Results from Years 2,3,4 and 5 (combined) of the Rolling Programme (2009/10 – 2012/13): Wales

Table 20: Percentage contribution of food groups to average daily potassium intake (mg) in Wales, by sex and age.

Aged 1.5 years and over ***2009/10 – 2012/13***

Food group[a]	Sex and age group (years)														
	Boys		**Total boys**	**Men**		**Girls**		**Total girls**			**Total**				
	4-10	11-18		19-64	65+	4-10	11-18		19-64	65+	1.5-3	4-10	11-18	19-64	65+
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Cereals and cereal products	18	17	17	15	17	16	17	17	14	15	14	17	17	14	16
of which:															
Pasta, rice, pizza and other miscellaneous cereals	4	5	4	4	1	3	5	4	3	1	3	3	5	3	1
White bread	3	5	4	3	3	4	4	4	3	3	3	4	4	3	3
Wholemeal bread	1	1	1	2	2	1	1	1	2	3	1	1	1	2	2
Brown, granary and wheatgerm bread	2	1	1	1	2	1	1	1	1	1	1	1	1	1	1
High fibre breakfast cereals	3	2	2	2	3	2	2	2	2	3	3	2	2	2	3
Other breakfast cereals	1	1	1	0	0	1	1	1	0	0	0	1	1	0	0
Biscuits	2	1	2	1	1	1	2	2	1	1	1	2	1	1	1
Buns, cakes, pastries and fruit pies	1	1	1	1	3	1	2	2	1	2	1	1	2	1	3
Puddings	1	1	1	0	1	1	0	1	0	1	1	1	0	0	1
Milk and milk products	23	14	18	12	13	20	10	15	13	16	29	21	12	12	15
of which:															
Whole milk (3.8% fat)	5	2	4	2	1	4	1	2	1	2	13	5	2	2	1
Semi skimmed milk (1.8% fat)	11	8	9	6	7	10	5	7	6	9	6	10	6	6	8
1% milk	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Skimmed milk (0.5% fat)	1	0	0	1	1	0	0	0	2	2	0	0	0	1	1
Other milk and cream	2	1	1	1	1	1	1	1	1	1	4	1	1	1	1
Yoghurt, fromage frais and other dairy desserts	3	1	2	2	2	3	2	2	3	3	4	3	1	2	2
Ice cream	1	1	1	0	0	1	1	1	0	0	1	1	1	0	0
Eggs and egg dishes	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Fat spreads[b]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meat and meat products	11	19	15	17	17	13	19	16	15	13	10	12	19	16	15
of which:															
Bacon and ham	1	2	2	3	2	2	2	2	2	2	1	1	2	2	2
Beef, veal and dishes	2	4	3	4	3	2	4	3	4	2	2	2	4	4	3
Lamb and dishes	0	0	0	1	1	0	0	0	0	2	0	0	0	0	2

Food group[a]	Sex and age group (years)														
	Boys		Total boys	Men		Girls		Total girls			Total				
	4-10	11-18		19-64	65+	4-10	11-18		19-64	65+	1.5-3	4-10	11-18	19-64	65+
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Pork and dishes	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
Coated chicken and turkey	1	2	2	0	0	2	2	2	0	0	1	1	2	0	0
Chicken, turkey and dishes	3	5	4	6	5	3	6	5	6	4	2	3	6	6	4
Burgers and kebabs	0	1	1	0	0	1	1	1	0	0	0	1	1	0	0
Sausages	1	2	2	1	1	1	1	1	1	1	1	1	2	1	1
Meat pies and pastries	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1
Other meat, meat products and dishes	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1
Fish and fish dishes	2	2	2	4	4	2	2	2	3	5	3	2	2	3	4
of which:															
White fish coated or fried including fish fingers	1	1	1	1	1	1	0	1	1	2	2	1	0	1	2
Other white fish, shellfish, fish dishes and canned tuna	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1
Oily fish	0	0	0	1	1	0	0	0	1	2	0	0	0	1	2
Vegetables and potatoes	22	27	25	25	25	23	26	25	28	26	18	22	27	26	25
of which:															
Salad and other raw vegetables	1	1	1	2	2	2	2	2	3	3	1	1	2	2	3
Vegetables (not raw) including vegetable dishes	5	7	6	6	6	5	6	6	8	7	6	5	7	7	7
Chips, fried and roast potatoes and potato products	10	13	11	10	9	9	10	10	9	7	7	9	12	9	8
Other potatoes, potato salads and dishes	6	6	6	7	7	7	7	7	8	9	4	6	7	7	8
Savoury snacks	4	4	4	2	1	4	5	5	2	1	2	4	4	2	1
Nuts and seeds	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Fruit	9	5	6	6	7	11	5	8	7	9	14	10	5	7	8
Sugar, preserves and confectionery	2	2	2	1	1	2	2	2	1	1	1	2	2	1	1
of which:															
Chocolate confectionery	1	2	1	1	0	1	1	1	1	1	1	1	2	1	0
Non-alcoholic beverages[c]	7	6	6	6	7	7	7	7	9	8	6	7	7	7	8
of which:															
Fruit juice	5	4	4	1	1	4	4	4	2	1	4	5	4	1	1
Soft drinks, not low calorie	0	1	1	1	0	1	1	1	0	0	1	1	1	0	0
Soft drinks, low calorie	1	1	1	0	0	1	0	1	0	0	1	1	1	0	0
Tea, coffee and water	0	1	1	4	6	1	1	1	6	7	0	0	1	5	7

Food group[a]	Sex and age group (years)														
	Boys		Total boys	Men		Girls		Total girls			Total				
	4-10	11-18		19-64	65+	4-10	11-18		19-64	65+	1.5-3	4-10	11-18	19-64	65+
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Alcoholic beverages	0	2	1	6	4	0	1	1	3	1	0	0	1	5	2
of which:															
Wine	0	0	0	1	1	0	0	0	2	1	0	0	0	1	1
Beer, lager, cider and perry	0	2	1	5	2	0	1	0	2	0	0	0	1	3	1
Miscellaneous[d]	2	3	2	4	2	2	3	3	3	4	2	2	3	4	3
Dry weight beverages	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1
Soup, manufactured/retail and homemade	1	1	1	2	1	0	1	1	1	1	0	1	1	1	1
Savoury sauces, pickles, gravies and condiments	1	2	2	1	1	1	2	2	1	1	1	1	2	1	1
Average daily total potassium intake mg	2265	2463	2376	2921	2691	2024	2065	2047	2550	2551	1865	2147	2269	2734	2613
Bases (unweighted)	*83*	*81*	*164*	*130*	*54*	*66*	*94*	*160*	*198*	*79*	*67*	*149*	*175*	*328*	*133*

[a] Food groups that contribute <0.5% to intake across all age/sex groups are excluded from the table. All other food groups are included.

[b] Some oils which are used as a condiment on bread or salads are included in this food group; however this food group does not include oils or fats used in cooking.

[c] Non-alcoholic beverages are reported as consumed with diluent water.

[d] In addition to dry weight beverages; soup, manufactured/retail and homemade; savoury sauces, pickles, gravies and condiments; and commercial toddler foods, Miscellaneous also includes nutrition powders and drinks.

Annex 2. Table of study characteristics: Summaries of meta-analyses

Study	Methods	Results[*]	Conclusions
Blood pressure			
Aburto et al., 2013 Effect of increased potassium intake on cardiovascular risk factors and disease: systematic review and meta-analyses. WHO review.	<u>Selection criteria</u> *Inclusion:* Randomised and non-randomised controlled trials; at least one group allocated to increased potassium and one group to lower potassium; intervention period of at least four weeks; used 24 hour urinary to measure potassium intake. *Exclusion*: Acutely ill or HIV positive; admitted to hospital; impaired urinary potassium excretion due to a medical condition or drug treatment. <u>Outcome measure</u> The effect of potassium intake on blood pressure.	Potassium intervention: <90 mmol/day to >155 mmol/day. Trial durations ranged from four weeks to 12 months. *All adults* (21 RCTs) SBP: -5.93 mm Hg (95%CI -10.15, -1.70) I^2=96% DBP: -3.78 mm Hg (95%CI -6.13, -1.43) I^2=93% *Excluding Obel et al., 1989 and Patki et al., 1990* SBP: -3.49 mm Hg (95% CI -5.15, -1.82) p<0.001 I^2=65% DBP: -1.96 mm Hg (95% CI -3.06, -0.86) p<0.001 I^2=55% *Adults with hypertension* (16 RCTs) SBP: -5.32 mm Hg (95% CI -7.20, -3.43) p=0.03 I^2=21% DBP: -3.10 mm Hg (95% CI -4.53, -1.66) p<0.001 I^2=24% *Adults without hypertension* (3 RCTs) SBP: -0.09 mm Hg (95% CI -0.95, 0.77) p=0.84 I^2=0% DBP: -0.56 mm Hg (95% CI -1.55, 0.42) p=0.21 I^2=37% *Children - Blood pressure (*3 RCTs) SBP: -0.28 mm Hg (95% CI -1.05, 0.49) p=0.47 I^2=0% DBP: -0.92 mm Hg (95% CI -2.00, 0.16) (I^2 & p-value not reported)	Increased potassium intake resulted in a significant decrease in SBP & DBP in the participants with hypertension at baseline but not in the participants without hypertension. Evidence assessed as moderate to high quality.
Binia et al., 2015 Daily potassium intake and sodium-to-potassium ratio in the reduction of blood pressure: a meta-analysis of	<u>Selection criteria</u> *Inclusion:* RCTs; at least one group with increased potassium intake, by supplements or food/dietary advice, and at least one control group with lower or unchanged potassium intake; adults 18 years plus; healthy population or a population at risk of or already having hypertension; used 24 hour urinary to measure potassium intake; report SBP and DBP at the end of the intervention;	Potassium intervention: 30-200 mmol/day[*]. Trial duration ranged from four weeks to 12 weeks. *All participants* (15 RCTs) SBP: -4.7 mm Hg (95% CI -7.0, -2.4) p<0.09 I^2=79.7% DBP: -3.5 mm Hg (95% CI -5.7, -1.3) p=0.002, I^2=91% *Participants with hypertension* (10 RCTs) SBP: -6.8 mm Hg (95% CI -9.3, -4.3) p<0.001, I^2=54.1% DBP: -4.6 mm Hg (95% CI -7.5, -1.8) p=0.001, I^2=87.4% *Meta-regression analysis*	Potassium supplementation reduced blood pressure in all participants. The effect was greater in hypertensive participants not on medication. In a meta-regression analysis, every unit of

[*] 1mmol = 39.1mg potassium

Study	Methods	Results*	Conclusions
randomised controlled trials.	clinical trials with at least a 4 week treatment period. *Exclusion:* Patients with severe illness (e.g. chronic kidney disease); infected with HIV; hospitalized; patients under antihypertensive treatment. Outcome measure Relationship between potassium intake, sodium-to-potassium ratio and reduction in blood pressure.	Every unit of reduction in sodium/potassium associated with: SBP: -2.1 mm Hg (95% CI -4.1, -0.1) p=0.035.	reduction in sodium/potassium was associated with a decrease in SBP. Sodium intake did not change significantly following intervention in any of the studies included in the analysis, as indicated by measurement of daily (24h) urinary sodium excretion.
Dickinson et al., 2006 Potassium supplementation for the management of primary hypertension in adults. Cochrane review.	Selection criteria *Inclusion:* RCTs of parallel or crossover design; comparing potassium supplements with a placebo, no treatment or usual care; treatment follow-up of more than 8 weeks; participants over 18 years with raised BP (SBP >140 mm Hg or DBP >85 mm Hg), SBP and DBP reported at end of follow-up. *Exclusion:* Pregnant participants; received hypertensive medication which changed during the study; potassium supplementation combined with other interventions. Outcome measure The effect of potassium supplementation on BP and other health outcomes.	425 participants; mean age 50y; 48-120mmol/day potassium supplement; 1 trial increased potassium intake via the diet (≥100mmol/day). Trial duration ranged from 8 to 14 weeks. *All trials* (5 RCTs) SBP: -11.2 mm Hg (95% CI -25.2, 2.7) p=0.11 I^2=98% DBP: -5.0 mm Hg (95% CI -12.5, 2.4) p=0.19 I^2=99% *Excluding the trial by Obel (1989)* SBP: -3.9 mm Hg (95% CI -8.6, 0.8) p=0.11 I^2=73% DBP: -1.5 mm Hg (95% CI -6.2, 3.1) p=0.52 I^2=95%	There was no significant reduction in SBP & DBP with potassium supplements.

Study	Methods	Results*	Conclusions
Geleijnse et al., 2003 Blood pressure response to changes in sodium and potassium intake: a meta-regression analysis of randomised trials.	<u>Selection criteria</u> *Inclusion:* RCTs; adult population (18 years or above); published after 1966. *Exclusion:* Lack of BP data; co-intervention where the effect of sodium and potassium could not be separated; diseased population (e.g. renal, diabetic patients); non-placebo control group; less than two weeks of intervention. <u>Outcome measure</u> The effect of potassium supplementation on blood pressure.	Mean age 45y (SD± 12), 60% (SD± 35) men, potassium supplement range 17-120 mmol/day; trial duration ranged from 2 weeks to 114 weeks. Median increase in potassium 44 mmol/day. *All adults* (27 RCTs) SBP -2.42 mm Hg (95% CI -3.75, -1.08) (no p-value reported) DBP -1.57 mm Hg (95% CI -2.65, -0.50) (no p-value reported) *Adults without hypertension* (11 RCTs) SBP -0.97 mm Hg (95% CI -3.07, 1.14) DBP -0.34 mm Hg (95% CI -2.04, 1.36) *Adults with hypertension* (19 RCTs) SBP -3.51 mm Hg (95% CI -5.31, -1.72) DBP -2.51 mm Hg (95% CI -3.96, -1.06) *Initial 24hr sodium excretion* SBP ≤150 mmol (12 trials) -1.76 mm Hg (95% CI -4.12, 0.61) >150 mmol (18 trials) -2.95 mm Hg (95% CI -5.03, -0.88) p=0.49 DBP ≤150mmol (12 trials) -0.63 mm Hg (95% CI -2.41, 1.16) >150 mmol (18 trials) -2.35 mm Hg (95% CI -3.93, -0.77) p=0.18 All reported data above adjusted for: age, proportion of males, initial blood pressure, initial 24 h urinary sodium and potassium excretions and changes in 24 h urinary potassium excretion during the trial.	SBP and DBP decreased with increased potassium intake. Initial 24 hour sodium excretion had no effect on BP during potassium supplementation.

Study	Methods	Results[*]	Conclusions
Whelton et al., 1997 Effects of oral potassium on blood pressure.	<u>Selection criteria</u> *Inclusion:* Human experimentation; include potassium treatment intervention and concurrent control group; RCTs; report mean BP changes after intervention period. *Exclusion:* Not randomised; lack of control group; antihypertensive drug therapy in control but not treatment group; comparison of treatment with potassium chloride vs treatment with sodium chloride; comparison of treatment with combined potassium supplementation and sodium reduction intervention vs control treatment with a normal diet; differences in other dietary nutrients between treatment and intervention group; absence of data to calculate the mean change in BP from baseline to end of intervention. <u>Outcome measure</u> The effect of potassium supplementation on blood pressure.	Age 18-79y, potassium supplement 17-20 mmol/day, pre-treatment urinary potassium 39-79 mmol/day; mean net change in urinary potassium 12-129 mmol/day; trial duration 4 days to 3 years. Mean change in urinary potassium excretion 53 mmol/day. *All trials* (33 RCTs: 20 in hypertensive, 12 in normotensive participants) SBP: -4.44 mm Hg (95% CI -6.36, -2.53) p<0.001 DBP: -2.45 mm Hg (95% CI -4.16, -0.74) p<0.01 *After excluding Obel 1989* SBP: -3.11 mm Hg (95% CI -4.93, -1.91) p<0.001 DBP: -1.97 mm Hg (95% CI -3.42, -0.52) p<0.01 *Participants with hypertension* SBP: -4.4 mm Hg (95% CI -6.6, -2.2) DBP: -2.5 mm Hg (95% CI -4.9, -0.1) *Participants without hypertension* SBP: -1.8 mm Hg (95% CI: -2.9, -0.6) DBP: -1.0 mm Hg (95% CI: -2.1, 0.0) *Urinary sodium excretion* (30 RCTs) SBP: <140 mmol/day -1.2 mm Hg (95% CI -2.4, 0.0) 140-164 mmol/day -2.1 mm Hg (95% CI -4.0, -0.3) ≥165 mmol/day -7.3 mm Hg (95% CI -10.1, -4.6) p<0.001 DBP: <140 mmol/day 0.1 mm Hg (95% CI -1.0, 1.1) 140-164 mmol/day -1.4 mm Hg (95% CI -2.8, 0.0) ≥155 mmol/day -4.7 mm Hg (95% CI -8.3, -1.1) p<0.001	Increased potassium intake resulted in a significant reduction in SBP and DBP. There was a significant treatment related reduction on SBP and DBP as urinary sodium excretion increased during follow-up.

Study	Methods	Results*	Conclusions
Cardiovascular disease			
Aburto et al., 2013 Effect of increased potassium intake on cardiovascular risk factors and disease: systematic review and meta-analyses. WHO review.	<u>Selection criteria</u> *Inclusion:* Randomised and non-randomised controlled trials; at least one group allocated to increased potassium and one group to lower potassium; intervention period of at least four weeks; used 24hour urines to measure potassium intake. *Exclusion*: Acutely ill or HIV positive; admitted to hospital; impaired urinary potassium excretion due to a medical condition or drug treatment. <u>Outcome measure</u> The effect of potassium intake on blood pressure.	10 PCS; n=859-38,726; age 25-79+y; follow-up: 4.5-19y. *Stroke risk* (9 cohorts) RR 0.76 (95% CI 0.66, 0.89) p=<0.001 Potassium intake 90-120 mmol/day: RR 0.70 (95% CI 0.56, 0.88) Potassium intake <90 mmol/day: RR 0.82 (95% CI 0.71, 0.93) - not statistically different from higher intake. *CVD risk* (4 cohorts, n=29,067) RR 0.88 (95% CI 0.70, 1.10) p=0.27 *CHD risk* (3 cohorts) RR 0.96 (95% CI 0.78, 1.19) p=0.72	A beneficial effect of higher potassium intake on risk of incident stroke but not of total CVD or CHD; however, because few studies have reported these outcomes, detecting an effect is difficult.
D'Elia et al., 2011 Potassium intake, stroke, and cardiovascular disease. A meta-analysis of prospective studies.	<u>Selection criteria</u> *Inclusion:* Original article; prospective design; adult population; assessment of potassium intake as baseline exposure; fatal or nonfatal stroke, CVD, and/or CHD determined prospectively as outcome; report number of participants exposed and rate or number of events in different categories of potassium intake; report RR or HR for potassium intake categories; follow-up of at least 4 years. <u>Outcome measure</u> The relation between level of habitual potassium intake and the incidence of cardiovascular disease.	247,510 participants; average potassium intakes 45-85 mmol/day; weighted average follow-up time 12.2y (5-19y). *Stroke risk* (11 cohorts) Average weighted difference: 42.1 mmol/day. RR: 0.79 (95% CI 0.68, 0.90) p=0.0007 I^2=55% *Update report stroke risk* (14 cohorts) Average weighted difference: 38.5 mmol/day. RR: 0.80 (95% CI 0.72, 0.90) p=0.03 I^2=47% Dose-response: every 25.6 mmol/day increase in potassium, a 10% reduction in stroke risk: RR: 0.90 (95% CI: 0.84, 0.96) *CHD risk* (6 cohorts) Average weighted potassium intake difference: 35.3 mmol/day.	Increasing dietary potassium intake exerted a protective effect against stroke but was not significant for CHD or CVD risk.

Study	Methods	Results*	Conclusions
		RR: 0.92 (95% CI 0.81, 1.04) p=0.18 I^2=45% *CVD risk* (4 cohorts) Average weighted potassium intake difference: 33.4 mmol/day. RR: 0.85 (95% CI 0.62, 1.16) p=0.31 I^2=71%	
D'Elia et al., 2014 Potassium-rich diet and risk of stroke: Updated meta-analysis.	Same as D'Elia et al., 2011	Update report of D'Elia et al., 2011. 3 additional PCS met inclusion criteria. *Stroke risk* (12 PCS (14 cohorts); n=333,250; 10,659 events) Average weighted difference: 38.5 mmol potassium/d. RR 0.80 (95% CI 0.72, 0.90) no p-value reported. Dose-response: every 25.6 mmol/d increase in K intake, 10% reduction in stroke risk: RR 0.90 (95% CI 0.84, 0.96).	Results of the updated meta-analysis reaffirm the favourable effect of dietary K intake on the risk of stroke. This increase in K could avert 1M deaths from stroke per year on a worldwide scale, given the World Heart Federation report of over 5.5M stroke deaths a year.
Larsson et al., 2011 Dietary potassium intake and risk of stroke. A dose-response meta-analysis of prospective studies.	<u>Selection criteria</u> *Inclusion:* prospective cohort studies; exposure potassium intake; outcome nonfatal and/or fatal stroke; report RR and 95% CI for at least 3 quantitative categories of potassium intake; RR adjusted for at least age and sex. <u>Outcome measure</u> Association between potassium intake and stroke risk.	10 PCS, 268,276 participants. *Pooled RR of stroke for each 1000 mg/day increase in potassium intake:* RR: 0.90 (95% CI 0.83, 0.97) p=0.03 I^2=50.8%	Statistically significant inverse association between potassium intake and risk of stroke. 1 g/day potassium decreased risk of stroke by 11%.

Study	Methods	Results[*]	Conclusions
Bone health			
Lambert et al., 2015 The effect of supplementation with alkaline potassium salts on bone metabolism: a meta-analysis.	<u>Selection criteria</u> *Inclusion:* RCTs and metabolic studies in adults. Parallel or cross-over design, metabolic or community-based intervention studies. Administration of potassium bicarbonate or potassium citrate at all dosages and for any duration was considered. Studies were also included if supplementation was combined with other forms of dietary or pharmaceutical manipulation, such as high protein or salt intake or diuretic administration. *Exclusion:* Studies on patients with kidney disease, metabolic bone disease or following renal, bariatric or other surgery or in pregnant or lactating women. Studies were also excluded from the main analysis if the control group received a treatment other than placebo or 'no treatment'. <u>Outcome measure</u> Urinary calcium excretion, markers of bone resorption and formation, bone mass density and NAE.	7 RCTs, 7 metabolic studies. Trial duration ranged from four weeks to three years for the RCTs and ≤4 weeks for the metabolic cross-over studies. *Calcium excretion* Potassium bicarbonate (7 trials) (30-120 mmol/day potassium). SMD -1.03 (95% CI -0.03, -2.03) p=0.04 I^2=93% Potassium citrate (7 trials) (40-90 mmol/day). SMD -1.03 (95% CI -1.85, -0.21) p=0.01 I^2=90% *Net acid excretion* Potassium bicarbonate (4 trials) (60-120 mmol/day). SMD -5.73 (95% CI -9.30, -2.16) p=0.002 I^2=95% Potassium citrate (3 trials) (60-90 mmol/day). SMD -4.88 (95% CI -7.73, -2.04) p=0.0008 I^2=97% *Bone resorption marker NTX* Potassium bicarbonate (3 trials) (67.5-90 mmol/day). SMD -7.62 (95% CI -14.97, -0.26) p=0.04 I^2=47% Potassium citrate (4 trials) (57.5-90 mmol/day). SMD -4.36 (95% CI -5.19, -3.53) p<0.00001 I^2=0% *Combined bone formation markers* Potassium bicarbonate (osteocalcin, 3 trials) (60-120 mmol/day). SMD 0.06 (95% CI -0.26, 0.39) p=0.70 I^2=0% Potassium citrate (osteocalcin & BAP, 6 trials) (40-90 mmol/day). SMD 0.14 (95% CI -0.34, 0.62) p=0.57 I^2=80%	Supplementation with alkaline potassium salts leads to a significant decrease in renal calcium excretion and acid excretion. The authors concluded that the observed reduction in bone resorption indicates a potential benefit to bone health.

Annex 3. Studies included in meta-analyses

Reference	Intervention potassium	Aburto et al., 2013	Binia et al., 2015	Dickinson et al., 2006	Geleijnse et al, 2003	Whelton et al., 1997	Aburto et al., 2013	D'Elia et al., 2011	D'Elia et al., 2014	Larsson et al., 2011	Lambert et al., 2015
		Blood pressure	Blood pressure	Blood pressure	Blood pressure	Blood pressure	CVD	CVD	CVD	CVD	Bone health
Skrabel et al. 1981	KCl				X	X[a]					
Khaw & Thom 1982	KCl				X	X					
MacGregor et al., 1982	KCl	X	X		X	X					
Sakhaee et al., 1983	K citrate										X
Richards et al., 1984	KCl	X	X		X	X					
Bulpitt et al., 1985	KCl	X			X	X					
Kaplan et al., 1985	KCl	X			X	X					
Smith et al., 1985	KCl	X	X		X	X					
Zoccali et al., 1985	KCl				X	X					
Barden et al., 1986	KCl	X	X		X	X					
Chalmers et al., 1986	Diet	X	X	X	X	X[a]					
Matlou et al., 1986	KCl	X	X		X	X					
Poulter & Sever., 1986	KCl				X	X					
Grobbee et al., 1987	KCl	X			X	X					
Khaw et al., 1987	Diet						X	X	X	X	
Medical Research Council, 1987	KCl				X	X					
Siani et al., 1987	KCl	X	X	X	X	X					
Svetkey et al., 1987	KCl			X	X	X					
Cushman & Langford 1988	KCl				X	X					
Forrester & Grell, 1988	KCl	X									
Grimm et al., 1988	KCl					X					
Nowson et al., 1988	Diet				X						

Reference	Intervention potassium	Aburto et al., 2013	Binia et al., 2015	Dickinson et al., 2006	Geleijnse et al, 2003	Whelton et al., 1997	Aburto et al., 2013	D'Elia et al., 2011	D'Elia et al., 2014	Larsson et al., 2011	Lambert et al., 2015
		Blood pressure	Blood pressure	Blood pressure	Blood pressure	Blood pressure	CVD	CVD	CVD	CVD	Bone health
Krishna et al., 1989	KCl					X					
Lemann et al., 1989	K bicarbonate										X
Obel, 1989	KCl	X	X	X		X					
Grimm et al., 1990	KCl				X						
Hypertension Prevention Trial, 1990	Diet					X					
Mullen & O'Connor, 1990	KCl & K citrate				X	X[a]					
Patki et al., 1990	KCl	X	X		X	X					
Barden et al., 1991	KCl					X					
Overlack et al., 1991	KCl & K bicarbonate			X		X					
Siani et al., 1991	KCl	X			X						
Valdes et al., 1991	KCl	X	X		X	X					
Fotherby & Potter, 1992	KCl	X	X		X	X					
Smith et al., 1992	KCl					X					
Trials of Hypertension Prevention, 1992	KCl	X									
Sebastian et al., 1994	K bicarbonate										X
Whelton et al., 1995	KCl	X	X		X	X					
Brancati et al., 1996	KCl				X	X					
Tunstall-Pedoe et al., 1997	Diet							X	X		
Ascherio et al., 1998	Diet						X	X	X	X	
Kawano et al., 1998	KCl	X			X						
Iso et al., 1999	Diet						X	X	X	X	

Reference	Intervention potassium	Aburto et al., 2013	Binia et al., 2015	Dickinson et al., 2006	Geleijnse et al, 2003	Whelton et al., 1997	Aburto et al., 2013	D'Elia et al., 2011	D'Elia et al., 2014	Larsson et al., 2011	Lambert et al., 2015
		Blood pressure	Blood pressure	Blood pressure	Blood pressure	Blood pressure	CVD	CVD	CVD	CVD	Bone health
Bazzano et al., 2001	Diet						X	X	X	X	
Gu et al., 2001	KCl	X	X								
Green et al., 2002	Diet							X	X	X	
Sellmeyer et al., 2002	K citrate										X
Frassetto et al., 2005	K bicarbonate										X
Sakhaee et al., 2005	K citrate										X
Geleijnse et al., 2007	Diet						X	X	X	X	
Larsson et al., 2008	Diet						X	X	X	X	
Macdonald et al., 2008	K citrate										X
Umesawa et al., 2008	Diet						X	X	X	X	
Weng et al., 2008	Diet						X	X	X	X	
Ceglia et al., 2009	K bicarbonate										X
Cook et al., 2009	Diet						X	X	X		
Dawson-Hughes et al., 2009	K bicarbonate										X
Karp et al., 2009	K citrate										X
Berry et al., 2010	Diet & K citrate	X	X								
He et al., 2010	K bicarbonate	X	X								X
Larsson et al., 2011	Diet								X	X	
O'Donnell et al., 2011	Diet						X		X		
Buehlmeier et al., 2012	K bicarbonate										X
Moseley et al., 2012	K citrate										X
Jehle et al., 2013	K citrate										X
Sluijs et al., 2014	Diet								X		

[a] Contains at least three intervention diets and a control diet allowing two comparisons each to be included in the meta-analysis.

Annex 4. Table of study characteristics - Individual studies assessing the effect of different potassium salts on blood pressure

Study Country	Study participants and design	Intervention*	Baseline blood pressure	Post intervention blood pressure	Results and comments
He et al., 2010 Effects of potassium chloride and potassium bicarbonate on endothelial function, cardiovascular risk factors, and bone turnover in mild hypertensives. UK	n=46 Male=30, Female=12 finished the study. Mean age: 51y SBP 140-170mmHg or DBP 90-105mmHg. Randomised, double-blind crossover trial.	All placebo 4 weeks. Either: K bicarbonate (64 mmol/day) 4 weeks. Or KCl (64 mmol/day) 4 weeks.	Ambulatory 24-hour BP: SBP: 140 mm Hg ± 8 mm Hg DBP: 87 mm Hg ± 8 mm Hg	*Placebo* SBP: 142 mm Hg DBP: 88 mm Hg *KCl* SPB: 139 mm Hg DBP: 87 mm Hg *K bicarbonate* SBP: 142 mm Hg p=0.057 vs KCl DBP: 89 mm Hg	There was no significant change in office BP with either potassium salt compared with placebo. 24-hour and daytime systolic BPs were slightly lower with potassium chloride compared with potassium bicarbonate but not compared with placebo.
Braschi & Naismith, 2008 The effect of a dietary supplement of potassium chloride or potassium citrate on blood pressure in	n=127 Both male and female included. Age: 22-65y SBP <u><</u>160 mm Hg and DBP <u><</u>105 mm Hg. Randomised, double-	KCl and K citrate 30 mmol/d (6 weeks).	*KCl* SBP: 112 mm Hg DBP: 68 mm Hg *K citrate* SBP: 115 mm Hg DBP: 70 mm Hg *Control* SBP: 108 mm Hg DBP: 66 mm Hg	<u>*3 weeks*</u> *KCl* SBP: 108 mm Hg p=<0.05 DBP: 66 mm Hg p=<0.05 *K citrate* SBP: 110 mm Hg p=<0.01 DBP: 67 mm Hg p=<0.005 <u>*6weeks*</u> *KCl* SBP: 106 mm Hg p=<0.005	An increase in dietary potassium of 30 mmol/d significantly decreases blood pressure. There was no difference between types of potassium taken.

* 1mmol = 39.1mg potassium

Study Country	Study participants and design	Intervention*	Baseline blood pressure	Post intervention blood pressure	Results and comments
predominantly normotensive volunteers. UK	blind placebo-controlled trial.			DBP: 65 mm Hg p=<0.01 *K citrate* SBP: 108 mm Hg p=<0.005 DBP: 67 mm Hg p=<0.005	
He et al., 2005 Effect of short-term supplementation of potassium chloride and potassium citrate on blood pressure in hypertensives. UK	n=14 Male=11, Female=3 Mean age: 51± 9 years. All essential hypertension (SBP ≥140 mm Hg &/or DBP ≥90 mm Hg). Randomised crossover trial.	KCl, 96 mmol/d (1 week). K citrate, 96 mmol/d (1 week). 1 week washout between 2 treatment periods.	SBP: 151 mm Hg ± 16 mm Hg. DBP: 93 mm Hg ± 7 mm Hg.	*KCl* SBP: 140 mm Hg ± 12 mm Hg DBP: 88 mm Hg ± 7 mm Hg *K citrate* SBP: 138 mm Hg ± 12 mm Hg DBP: 88 mm Hg ± 6 mm Hg	SBP & DBP significantly decreased from baseline following potassium supplementation, however there was no significant difference in BP between KCl and K citrate.
Mullen & O'Connor, 1990 Potassium effects on blood pressure: is the conjugate anion important? USA	n=24 100% male. Adults. Healthy normotensive with supine DBP <90 mm Hg. Randomised crossover trial.	KCl, 75 mmol/d (2 weeks). K citrate, 75mmol/d (2 weeks). Placebo (2 weeks).	Not reported	*KCl* Supine blood pressure SBP: 117 mm Hg ± 2 mm Hg DBP: 72 mm Hg ± 2 mm Hg Upright blood pressure SBP: 122 mm Hg ± 3 mm Hg DBP: 83 mm Hg ± 2 mm Hg *K citrate* Supine blood pressure SBP: 115 mm Hg ± 2 mm Hg DBP: 71 mm Hg ± 2 mm Hg Upright blood pressure SBP: 122 mm Hg ± 3 mm Hg	Neither potassium chloride nor potassium citrate affected blood pressure.

Study Country	Study participants and design	Intervention*	Baseline blood pressure	Post intervention blood pressure	Results and comments
				DBP: 82 mm Hg ± 2 mm Hg *Placebo* Supine blood pressure SBP: 117 mm Hg ± 2 mm Hg DBP: 69 mm Hg ± 2 mm Hg Upright blood pressure SBP: 122 mm Hg ± 3 mm Hg DBP: 81 mm Hg ± 2 mm Hg	
Overlack et al., 1995 Potassium citrate versus potassium chloride in essential hypertension. Effects on hemodynamic, hormonal and metabolic parameters. Germany (Article in German, most of information taken from abstract that is in English)	n=25 Male=18, Female=7 Mean age: 48 years (24-70 years). All with hypertension. Randomised crossover trial.	KCl, 120 mmol (8 weeks). K citrate, 120 mmol (8 weeks). Placebo (8 weeks). 4 week washout between each treatment period.	*K citrate* SBP: 147.5 ± 3.8 mm Hg DBP: 98.5 ± 2.3 mm Hg *KCl* SBP: 142.3 ± 3.5 mm Hg DBP: 97.1 ± 1.9 mm Hg *Placebo* SBP: 148.8 ± 5 mm Hg DBP: 97.9 ± 3 mm Hg	<u>4 weeks</u> *K citrate* SBP 144.9 mm Hg ± 3.6 mm Hg DBP 98 mm Hg ± 2.2 mm Hg *KCl* SBP 143.3 mm Hg ± 3.6 mm Hg DBP 93.8 mm Hg ± 2.7 mm Hg *Placebo* SBP 146.7 mm Hg ± 3.9 mm Hg DBP 98.8 mm Hg ± 3.1 mm Hg <u>8 weeks</u> *K citrate* SBP: 141.3 mm Hg ± 3.8 mm Hg DBP: 94.7 mm Hg ± 2.5 mm Hg p<0.05 *KCl* SBP: 143.9 mm Hg ± 3.7 mm Hg DBP: 94.6 mm Hg ± 3.1 mm Hg *Placebo* SBP: 148.3 mm Hg ± 4.3 mm Hg DBP: 98.8 mm Hg ± 3.1 mm Hg	After 8 weeks of supplementation there was only a significant reduction in SBP and DBP following potassium citrate supplementation.

Annex 5. Table of study characteristics - Individual studies reporting the effect of the sodium to potassium intake ratio on blood pressure

Study Country	Study participants and study design	Intervention*	Primary outcome & Na/K assessment	Results	Author's conclusions
Bompiani (1998) Effects of moderate low sodium/high potassium diet on essential hypertension: results of a comparative study. Italy	n=60 Mean age: 34y Male female ratio unspecified. Hypertensives. Medication – not reported. Double blinded randomised cross-over trial.	*Normal diet* (2 weeks) 160 mmol Na/d 80 mmol K/d *Low Na/high K* (2 weeks) 100 mmol Na/d 130 mmol K/d *Na:K Ratio* Normal diet: 2.29 Low Na/high K: 0.86	Change in SBP, DBP. 24-hour urine collection.	Normal diet v Low Na/high K diet *Resting blood pressures* SBP after: Normal diet: 163.2 ± 2.5 mm Hg Intervention diet:146.6 ± 1.8mmHg (p<0.001) DBP after: Normal diet: 93.3 ± 3.7 mm Hg Intervention diet: 87.6 ± 1.2 mm Hg (p< 0.05) Similar reductions were seen after dynamic exercise.	Results suggest moderate sodium restriction combined with high K intake may be useful in the management of essential hypertension.
Grobbee et al., (1987) Sodium restriction and potassium supplementation in young people with mildly elevated blood pressure.	n=40 Male=34, Female=6 Age range: 18-28y. Participant s with mild hypertension. No medication. Double-blind randomised cross-over study.	*Normal Na* (6 wks) Dietary restriction 90 mmol/d slow release Na tablet. *Low Na/High K* (6 wks) Dietary Na restriction 72 mmol/d slow release K tablets. *Low Na* (6 wks) – dietary restriction.	Changes in SBP, DBP. 24-hour urine collection.	6 weeks *Normal Na* SBP: 136.8 ± 1.8 mm Hg DBP: 73.5 ± 1.8 mm Hg *Low Na* SBP: 135.9 ± 1.8 mm Hg DBP: 73.7 ± 1.5 mm Hg *Low Na/High K* SBP: 135.0 ± 2.1 mm Hg DBP: 71.6 ± 1.7 mm Hg	Small hypertensive effect of moderate sodium restriction combined with high potassium intake in young hypertensive participants.

* 1mmol = 39.1mg potassium

Study Country	Study participants and study design	Intervention*	Primary outcome & Na/K assessment	Results	Author's conclusions
The Netherlands		*Urinary Na:K ratio* Normal Na: 1.68 Low Na: 0.77 Low Na/high K: 0.53		12 weeks *Normal Na* SBP: 136.5 ± 2.0 mm Hg DBP: 73.3 ± 1.5 mm Hg *Low Na* SBP: 135.7 ± 1.5 mm Hg DBP: 72.5 ± 1.6 mm Hg *Low Na/High K* SBP: 133.2 ± 1.9 mm Hg (p<0.05) DBP: 71.9 ± 1.5 mm Hg Significant reduction in SBP in low Na/high K group (p<0.05). No significant differences in SBP or DBP between placebo and low-Na groups.	
Smith et al., (1985) Moderate potassium chloride supplementation in essential hypertension: is it additive to moderate sodium restriction? UK	n=20 Mean age: 53y (range 30-66y). Male=11, Female=9 Patients with mild or moderate hypertension. No medication. Double-blind randomised cross-over study.	Diet restriction to approx. 70mmol/day NaCl throughout trial and starting one month prior. *High K / low Na* (28 days) 64 mmol/day KCl *Placebo* (28 days) Placebo tablet. *Urinary Na:K ratio* Restricted NaCl diet: 0.94 High K/low Na: 0.68 Placebo diet: 1.09	Supine and standing SBP, DBP. 24-hour urine collection.	*Placebo Group* Supine SBP: 162 ± 3.4 mm Hg DBP: 103 ± 2.0 mm Hg Standing SBP: 160 ± 3.5 mm Hg DBP: 111 ± 1.9 mm Hg *High K/low Na Group* Supine SBP: 160 ± 3.6 mm Hg DBP: 103 ± 2.4 mm Hg Standing SBP: 160 ± 4.5 mm Hg DBP: 110 ± 2.2 mm Hg	In patients who are able to moderately restrict their Na intake, doubling K as a chloride salt has little or no effect on BP.

Study Country	Study participants and study design	Intervention*	Primary outcome & Na/K assessment	Results	Author's conclusions
Zoccali et al., (1985) Effects of potassium on sodium balance, renin, noradrenaline and arterial pressure Scotland	<u>Participants with mild to moderate hypertension</u> n=23 (n=19 completed). Male=10, Female=9 Mean age: men, 41y (range 26-53y); female, 35y (range 26-53y). Untreated or not on medication for prior 2 months. Randomised cross-over trial. <u>Participants without hypertension</u> n=10 Age range: 20-29y 10=male Medication not reported. Metabolic study – no randomisation or placebo group reported.	<u>Participants with mild to moderate hypertension</u> *High K* (5 days) 100 mmol K/d *Normal diet* (5 days) Placebo tablet *Urinary Na:K ratio* High K: 1.40 Normal diet: 3.14 <u>Participants without hypertension</u> *Normal fixed diet* (first 5 days) Mean 145 mmol/d Na Mean 76 mmol/d K *High K* (5 days) Normal fixed diet + 100 mmol K/d *Unrestricted diet* (5 days) *Urinary Na:K ratio* Normal diet: 1.90 High K: 0.77	Change in SBP, DBP. 24-hour urine collection.	<u>Participants with mild to moderate hypertension</u> *Normal diet (placebo)* Lying SBP: 147 ± 4 mm Hg DBP: 92 ± 3 mm Hg Standing SBP: 147 ± 5 mm Hg DBP: 99 ± 3 mm Hg *Potassium treatment* Lying SBP: 146 ± 4 mm Hg DBP: 89 ± 3 mm Hg Standing SBP: 146 ± 5 mm Hg DBP: 99 ± 3 mm Hg <u>Participants without hypertension</u> *Normal fixed diet* Lying SBP: 117 ± 4 mm Hg DBP: 71 ± 2 mm Hg Standing SBP: 116 ± 4 mm Hg DBP: 83 ± 2 mm Hg *High K* Lying SBP: 113 ± 3 mm Hg DBP: 69 ± 3 mm Hg Standing	KCL supplementation did not reduce either SBP or DBP in these patient groups.

Study Country	Study participants and study design	Intervention*	Primary outcome & Na/K assessment	Results	Author's conclusions
				SBP: 110 ± 4 mm Hg DBP: 81 ± 2 mm Hg *Unrestricted* Lying SBP: 119 ± 4 mm Hg DBP: 66 ± 2 mm Hg Standing SBP: 118 ± 5 mm Hg DBP: 83 ± 3 mm Hg	
Fujita & Ando (1984) Hemodynamic and endocrine changes associated with potassium supplementation in sodium-loaded hypertensives Japan	n=23 Mean age: 49y Male=17, Female=6 Patients with mild to moderate hypertension. Antihypertensive medication discontinued at least 2 weeks before admission. Randomization/blinding not reported.	*Normal Na* (both groups, 3 days) 25 mmol Na 50 mmol K 140 mmol NaCl *Low Na* (both groups, 3 days) 25 mmol Na 50 mmol K *High Na (Group A, 6 days)* 25 mmol Na 50 mmol K 225 mmol NaCl *High Na/high K (Group B, 6 days)* 25 mmol Na 50 mmol K 250 mmol NaCl 96 mmol KCl *Urinary Na:K ratios* N/R	Change in mean blood pressure. 24h urine collection but no data on Na/K excretion provided.	*Group A* Normal Na: 108.2 ± 3.6 mm Hg Low Na: 100.4 ± 3.2 mm Hg High Na: 109.6 ± 2.4 mm Hg *Group B* Normal Na: 106.5 ± 2.5 mm Hg Low Na: 100.0 ± 1.8 mm Hg High Na/High K: 97.0 ± 2.6$^{\alpha}$ mm Hg $^{\alpha}$Lower MAP rise in Group B than Group A (p< 0.01)	KCl may prevent a rise in BP with NaCl loads in patients with hypertension.

Study Country	Study participants and study design	Intervention*	Primary outcome & Na/K assessment	Results	Author's conclusions
		40 mg furosemide administered on first day of low Na diet.			
Richards et al., (1984) Blood-pressure response to moderate sodium restriction and to potassium supplementation in milk essential hypertension New Zealand	n=12 Age: 19-52y Male=8, Female=4 Participants with mild hypertension, who had not taken medication for at least one month. Cross-over trial.	Each diet taken for at least 4 weeks. *Control diet* 180 mmol Na/d 60 mmol/d K *Low Na diet* 80 mmol Na/d 60 mmol/d K *High K diet* 180 mmol Na/d 200 mmol K/d *Urinary Na:K ratios* Not reported	Change in SBP and DBP. 24-hour urine Na/K provided in graph but data not provided. Stated that urine electrolyte excretion matched desired intake.	*Control diet* SBP: 136.7 ± 3.9 mm Hg DBP: 85.9 ± 2.4 mm Hg *Sodium restricted diet* SBP: 132.7 ± 4.5 mm Hg DBP: 82.9 ± 2.9 mm Hg *Potassium supplemented diet* SBP: 136.6 ± 4.2 mm Hg DBP: 85.1 ± 2.3 mm Hg	The results of sodium restriction or potassium supplementation have variable effects in individuals but overall the effects are very small.
Skrabel et al., (1984) Low-sodium diet versus low-sodium/high-potassium diet for treatment of hypertension Austria	n=21 Age: 21-69y Male=17, Female=4 Essential hypertension. n=12 on anti-hypertensive drugs; n=9 not on medication. Randomised cross-over trial.	*Low sodium* (4 weeks) 80 mmol Na/d Low Na dietary advice *Low sodium/high potassium* (4 weeks) 80 mmol Na/d 120 mmol K/d Low Na, high K dietary advice. *Urinary Na:K ratio* Low Na/high K: 0.85	Change in SBP, DBP and mean BP (supine, sitting and standing). 24-hour urine collection	Untreated patients (n=9) *No diet* SBP: 149.8 ± 8.7 mm Hg DBP: 92.1 ± 11.2 mm Hg *Low Na* SBP: 142.1 ± 10.7[β] mm Hg DBP: 91.1 ± 13.8 mm Hg *Low Na/High K* SBP: 144.1 ± 13.4 mm Hg DBP: 95.0 ± 14.8 mm Hg Treated patients (n=12)	Sodium restriction is effective in reducing SBP but a combined low Na/high K intervention does not further improve BP control.

Study Country	Study participants and study design	Intervention*	Primary outcome & Na/K assessment	Results	Author's conclusions
				No diet SBP: 150.7 ± 32.3 mm Hg DBP: 101.5 ± 19.0 mm Hg *Low Na* SBP: 144.5 ± 18.3 mm Hg DBP: 100.2 ± 16.1 mm Hg *Low Na/High K* SBP: 148.9 ± 21.7 mm Hg DBP: 100.3 ± 11.7 mm Hg $^{\beta}$Significantly different compared with no diet or low Na/high K diet (p<0.02)	
Skrabel et al., (1981) Low sodium/high potassium diet for prevention of hypertension: probable mechanisms of action Austria	n=20 Age: 21-25y Male=20 Participants without hypertension (10 with family history of hypertension). No medication Randomised cross-over trial.	Each diet taken for 2 weeks. NaCl achieved through diet manipulation, K provided through increased fruit and vegs, and K salts. *High Na/low K (usual diet)* 200 mmol NaCl/d 80 mmol K/d *High K* 200 mmol NaCl/d 200 mmol K/d *Low Na* Meals provided to achieve: 50 mmol NaCl/d 80 mmol K/d *Low Na/High K* 50 mmol NaCl/d	Changes in SBP, DBP. 24-hour urine collection.	*High Na/Low K (usual diet)* SBP: 125.0 ± 2.39 mm Hg DBP: 73.1 ± 2.17 mm Hg *Low K* SBP: 122.3 ± 2.32 mm Hg DBP: 70.1 ± 1.86 mm Hg *High Na* SBP: 123.3 ± 2.54 mm Hg DBP: 68.6 ± 1.98 mm Hg *Low Na/high K* SBP: 122.7 ± 1.81 mm Hg DBP: 69.6 ± 1.67 mm Hg No significant changes in SBP or DBP with either diet for group as a whole.	No significant changes in SBP or DBP with either diet for group as a whole.

Study Country	Study participants and study design	Intervention[*]	Primary outcome & Na/K assessment	Results	Author's conclusions
		200 mmol K/d *Urinary Na:K ratio* High Na/Low K: 2.95 High K: 1.34 Low Na: 0.62 Low Na/High K: 0.16			
Parfrey et al., (1981) Blood pressure and hormonal changes following alteration in dietary sodium and potassium in young men with and without a familial predisposition to hypertension UK	n=23 Age: 20-26y Male=5, Female=3 Participants without hypertension n=12 (parents with hypertension) n=11 (parents without hypertension). Medication – not reported. Randomised cross-over trial.	*High Na* (4 weeks) Normal diet 100 mmol Na *Low Na* (4 weeks)Avoidance of salty food No addition of NaCl at the table. *Low Na/High K* (for last 2 weeks of Low Na diet) Dietary advice continued 100 mmol K <u>Na:K ratio</u> *Parents with hypertension* Normal diet: 2.5 High Na: 4.0 Low Na: 2.2 Low Na/High K: 0.9 *Parents without hypertension* Normal diet: 2.5 High Na: 3.4 Low Na: 1.8 Low Na/High K: 1.1	Changes in SBP, DBP. 24-hour urine collection.	*Change in blood pressures between various dietary periods.* <u>Parents hypertensive group</u> *High Na to Low Na* SBP: 2.6 ± 1.1 mm Hg ($p<0.05$) DBP: 7.2 ± 1.7 mm Hg ($p<0.005$) *Low Na to Low Na/High K* SBP: 8.0 ± 2.2 mm Hg ($p<0.01$) DBP: 2.9 ± 2.5 mm Hg (NS) *High Na to low Na/High K* SBP: 10.5 ± 2.3 mm Hg ($p<0.001$) DBP: 11.2 ± 2.5 mm Hg ($p<0.001$) <u>Parents without hypertension group</u> *High Na to Low Na* SBP: 1.7 ± 3.0 mm Hg (NS) DBP: 7.8 ± 3.2 mm Hg ($p<0.05$) *Low Na to Low Na/high K* SBP: -4.2 ± 2.1 mm Hg (NS) DBP: -4.6 ± 2.3 mm Hg (NS) *High Na to low Na/high K* SBP: -2.1 ± 3.2 mm Hg (NS) DBP: 3.2 ± 2.5 mm Hg (NS)	In this age group there is a similar reduction in SBP and DBP in response to high sodium intake in participants with or without a predisposition to hypertension. However, with a low Na/high K diet, there was a differential response – young adults with a predisposition to hypertension had a significant reduction in both SBP and DBP; this was not seen in young adults without a predisposition to hypertension.

Study Country	Study participants and study design	Intervention*	Primary outcome & Na/K assessment	Results	Author's conclusions
Burstyn et al., (1980) Sodium and potassium intake and blood pressure UK	n=28 Age: 20-47y Male=14, Female=14 Participants without hypertension. Medication – not reported. Randomisation/ blinding not specified.	*High Na diet* (n=7, 8 days) 250 mmol NaCl (2 men took 300 mmol NaCl). Followed by 8 day control period. *Low Na/High K diet* (n=21, 22 days) 14-day control period at beginning and 10-day control after stage 2. Stage 1 (8 days) Replacement of table salt with mixture of 50% table salt 50% KCl. Stage 2 (14 days) Women: 64 mmol KCl Men: 80 mmol KCl *Na/K ratio* High Na: 5.69 High K: 1.4	Change in SBP, DBP. 24-hour urine collection.	<u>High Na diet</u> *Control* SBP: 120.1 ± 1.8 mm Hg DBP: 79.4 ± 1.6 mm Hg *NaCl* SBP: 117.2 ± 2.6 mm Hg DBP: 76.3 ± 2.3 mm Hg *Control* SBP: 117.7 ± 1.9 mm Hg SBP: 77.6 ± 2.0 mm Hg <u>Low Na / High K diet</u> *Control* SBP: 115.3 ± 1.6 mm Hg DBP: 79.5 ± 0.8 mm Hg *NaCl* SBP: 114.7 ± 1.6 mm Hg DBP: 80.2 ± 0.8 mm Hg *Slow K* SBP: 114.8 ± 1.4 mm Hg DBP: 80.2 ± 0.9 mm Hg *Control* SBP: 115.1 ± 1.2 mm Hg DBP: 80.5 ± 0.8 mm Hg	Increases in Na and K intake in normotensives in the short term has no effect on SBP or DBP.

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