

The Nutritional Wellbeing of the British Population

Scientific Advisory
Committee on Nutrition

2008

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Preface

This analysis of British dietary surveys indicates that there have been positive changes in the diet of the British adult population over the last fifteen years. For example the evidence shows a fall in the intake of fat and saturated fat, a decrease in the consumption of red meat, processed meat and meat-based dishes and an increase in fruit and vegetable consumption. These all reflect moves towards healthier patterns of intake.

However, there are further improvements needed in the diet of the British population, especially in those groups of the population who are particularly vulnerable, i.e. children and those in low income groups. The current dietary patterns of older children and young adults are a cause for considerable concern. As reported previously, greater attention has to be given to the diets of older people if they are to achieve better health with added years.

There is a need for immediate action to ensure further improvements in the patterns of food consumption and the intake of several nutrients. Together with other aspects of lifestyle, these changes are required to reduce the increasing risk of nutrition-related ill-health and disease such as obesity, diabetes, coronary heart disease, stroke, cancer and alcohol related diseases.



Professor Alan Jackson

Chair of the Scientific Advisory Committee on Nutrition

September 2008

Contents

	Preface	i
	Membership of the Scientific Advisory Committee on Nutrition	iv
1	Summary	1
	Recommendations	3
2	Section I: The Nutritional Health of the British population	20
	Background	20
	Diet and nutritional status of the population	22
	Dietary habits	23
	Energy and macronutrient intakes	43
	Micronutrient intake and status	71
	Salt	83
	Oral health	86
	Regional differences	87
	Socio-economic differences	88
	Low income diet and nutrition survey	90
	Ethnicity	90
	Summary and conclusion	91
3	Section II: Analysis of the micronutrient intake and status of British adults	94
	Aim	94
	Background	94
	Analysis by DRV and nutritional status cut-offs	95
	Method	95
	Results	105
	Discussion	115
	Analysis by quintile	117
	Method	117
	Results	117
	Discussion	133

Principal components analysis	134
Method	134
Results	134
Discussion	136
Conclusions	137
References	140
Annexes	145
1 Government policies and initiatives on nutrition	145
2 Notes to tables	158
3 Glossary and abbreviations	159
4 Principal component analysis methodology	161
5 Principal component analysis detailed results	162

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1 Summary

1. This report summarises the analysis of the results of the British National Diet and Nutrition Surveys (NDNS)¹⁻⁸. The aim of these nationwide surveys, undertaken at regular intervals across a representative sample of the British population, is to review the nutritional status of the British population; identify specific health outcomes where the population failed to meet dietary recommendations and to identify any specific groups at risk. This report also provides practical proposals for improvement where sections of the population have been shown to consume a poor diet. Special attention is paid to health outcomes not currently the focus of governmental policy.
2. There is no single analytical technique that can provide a definitive picture of diet and nutritional status in the British population. The analyses presented in this report use a range of appropriate analytical techniques to draw out general patterns in the diet and nutrition of the population.

This report is presented in two sections:

3. **Section I): The nutritional health of the British population:**
This section brings together the findings on food, macro and micronutrient dietary intakes and biochemical status from six surveys of different population age groups ranging from children aged 1 ½ years to adults aged 65 years and over¹.
4. **Section II): Analysis of the micronutrient intake and status of British adults:**
This section highlights main findings from a detailed secondary analysis of the most recent micronutrient intake and status data of the adult population based on data from the 2000/2001 NDNS of adults aged 19-64 years⁴⁻⁸. It describes the lifestyle, demographic and dietary characteristics associated with low intakes and borderline intakes of micronutrients i.e. intakes meeting minimum recommendations.

Current dietary recommendations:

5. The Committee on Medical Aspects of Food and Nutrition Policy (COMA) was set up in 1964 and was succeeded by the Scientific Advisory Committee on Nutrition (SACN), in 2001 to provide government with independent scientific advice on nutrition. The dietary targets and guidelines set by COMA and SACN are summarised in Table 1 (the recommendation for alcohol was provided by the Royal College of Physicians). These targets and guidelines were set with

¹ The NDNS programme does not cover children under 18 months of age, pregnant and lactating women or individuals living in institutions (except for adults aged 65+ years). The surveys are designed to be representative of the British population, so ethnic minorities and low-income groups are included, but not in large enough numbers for separate analysis.

the intention of promoting health and preventing nutrition related chronic disease. Examples of UK wide government initiatives to support these targets and guidelines are summarised in Annex 1.

Dietary reference values:

6. COMA set reference intake figures for food components⁹: for energy, estimated average requirement (EAR) values are set at levels of intake likely to meet the needs of 50% of the population. For total fat, saturated and trans fatty acids and non-milk extrinsic sugars dietary reference values (DRV) are the recommended maximum contribution these nutrients should make to the population average diet. For total carbohydrate, cis monounsaturated fatty acids and non-starch polysaccharide (NSP) the DRVs are recommended population averages. For protein, vitamins and minerals, reference nutrient intake (RNI) values are set at levels of intake considered likely to be sufficient to meet the requirements of 97.5% of the population and lower reference nutrient intake (LRNI) values (not protein) are set at levels of intake considered likely to be sufficient to meet the needs of only 2.5% of the population.
7. Section II of this report refers to “low intakes” which are defined as intakes below the LRNI for a given vitamin or mineral and “borderline intakes”, defined as intakes of a given vitamin or mineral at or above the LRNI, but less than the EAR (RNI for iodine and potassium)⁹.

Biochemical status:

8. The functional status of an individual for a given nutrient is largely determined by the dietary intake, but this can be modulated by factors such as genotype, smoking, and interaction with other nutrients and food components. Biochemical status describes the concentration of nutrients within the body available for use in biochemical processes and it is particularly useful in comparing changes in absorption, utilisation and excretion of nutrients over time. Also, because of the uncertainties in ascertaining the nutrient intake of individuals it is useful to have corroboration in the form of direct measures of blood nutrient status.
9. In both sections of this report “low biochemical status” corresponds to the concentration of specific status indices falling below a set threshold, for a given vitamin or mineral¹⁰.

⁹ The thresholds of status quoted in this report were those current at the time of each survey, full details and justification can be found in the survey reports. The biochemical status marker for vitamin D, plasma 25-OHD reflects the vitamin D absorption from the diet and from endogenous production in the body from exposure to sunlight.

Table 1: Summary of dietary recommendations

Recommendation		Population group	Reason for Recommendation	Intake ⁱ / meets recommendations?	
Fruit & vegetables	At least 5 x 80g portions/day (400g) (portion sizes are smaller for children under 5) ^{io}	Adults	Reduce risk of some cancers, cardiovascular disease and many other chronic conditions ^{io} .	Mean 2.8 portions/day.	No
Oily fish ⁱⁱ	At least 1 portion / week (140g) ⁱⁱ .	Adults	Reduce the risk of cardiovascular disease ⁱⁱ .	Mean is below recommendations in all age groups of population, (0.3 portion/wk for adults),	No
Red and processed meat	Individual consumption should not rise and high consumers should consider a reduction with the aim of reducing population average (90g/day in 1998) ⁱⁱ .	All red meat consumers	To reduce cancer risk ⁱⁱ .	Mean intake of red and processed meat and meat based dishes has decreased since 1986/7 (138g/day, 79g/day 2000/01 and 155g/d, 96g/day in 1986/7 for men and women respectively) ⁱⁱⁱ .	–
Non-milk extrinsic sugars (NMES)	No more than 11% food energy ^{iv} or about 60g/day ⁹ .	All	NMES contribute to the development of dental caries ⁹ .	Up to 19% food energy across all population groups.	No
Fat	Population average 35% food energy (maximum) ⁹ .	All	To reduce risk of cardiovascular disease, and reduce energy density of diets ⁹ .	Mean intake 35% food energy	Yes
Saturated fat	Population average 11% food energy (maximum) ⁹ .	All	To reduce risk of cardiovascular disease, and reduce energy density of diets ⁹ .	Mean intake 13% food energy	No
Non-starch poly-saccharides	An average intake of 18g/day ⁹ .	Adults	To improve gastrointestinal health ⁹ .	Mean intake 15.2g/day for men, 12.6g/day women	No

ⁱ For adults unless stated otherwise. The NDNS programme does not cover children under 18 months of age, pregnant and lactating women or individuals living in institutions (except for people aged 65+ years). The surveys are designed to be representative of the British population, so ethnic minorities and low-income groups are included, but not in large enough numbers for separate analysis.

ⁱⁱ SACN encourage consumption of at least 2 portions (140g per portion) of fish per week (at least one of which should be oily). Men, boys and women past childbearing age can consume up to 4 portions and girls and women of child bearing age are advised to consume up to 2 portions of oily fish per weekⁱⁱ.

ⁱⁱⁱ Consumption figures include non-meat components of meat-based dishes, so figures for consumption of red and processed meat and meat-based dishes are not directly comparable with recommendations for red and processed meat. Detailed recipe analysis of composite processed products would be required to calculate red and processed meat content alone.

^{iv} Energy consumed as food and drink, excluding alcohol⁹

Recommendation		Population group	Reason for Recommendation	Intake / meets recommendations?	
Alcohol	No more than 3-4 units/day ^v ,	Men aged 18+ years	To reduce the risk of liver disease, cardiovascular disease, cancers, injury from accidents and violence ¹⁴	60% of population exceed daily recommendation	No
	No more than 2-3 units/day ¹³ .	Women aged 18+ years		44% of population exceed daily recommendation	No
Salt (sodium chloride)	Reduce population average to a maximum of 6g/day (2.4g sodium/day). (Proportionally lower for children) ¹⁵ .	Adults	To reduce risk of hypertension and cardiovascular disease ¹⁵ .	Mean salt intake 9.5g/day	No
Vitamins & minerals	Dietary Reference Values ² .	All	To promote optimum health and prevent deficiency ² .	Evidence of low intakes of some vitamins and minerals in different age groups, see main findings for details.	Not all
Dietary vitamin D ^{vi}	Dietary Reference Values set for young children, people aged 65 years and over and pregnant and breast feeding women ⁹ . Others with limited skin sunshine exposure also require dietary intake	All	To prevent vitamin D deficiency ¹⁶	Evidence of low status in most age groups especially older children, young adults and older people in institutions. Mean intakes below RNI for groups where this has been set.	No
Supplements ^{vii}	Vitamin D ¹⁷	Older Adults, housebound or living in institutions or who eat no meat or oily fish ¹⁷	To achieve adequate vitamin D status and reduce the risk of poor bone health ¹⁷ .	Vitamin D supplement use (including prescribed) in institutional older people was lower (mean 3%) than in the free-living group (mean 16%). Older people had low intakes and status of vitamin D.	No

^v One unit (8g alcohol) is approximately equivalent to half a pint of beer, lager or cider, a single measure (25ml) of spirits, a small glass (125ml) of wine or a small glass of sherry, port or other fortified wine.

^{vi} Dietary vitamin D is also recommended for infants, pregnant and lactating women and ethnic minority groups as these groups are at risk of deficiency

^{vii} Vitamin D supplements are also recommended for pregnant and lactating women¹⁶

Recommendation		Population group	Reason for Recommendation	Intake / meets recommendations?	
	Vitamins A and D unless adequate vitamin status assured from diverse diet including vitamin A and D rich foods and moderate exposure to sunlight ¹⁸ .	Children aged 1-5 years.	To ensure adequate intake and status ¹⁸ .	Children aged 1½-4½ years: 1/5 reported non-prescribed supplement use, mean vitamin D intakes are 18% of the RNI.	No
Energy intake	EAR for men 2500kcal/day, for women 2000kcal/day	Adults	Reduce the risk of chronic diseases such as cardiovascular disease, some cancers, and type 2 diabetes ⁹ .	80-90% of EAR.	Yes ^{viii}
Body weight	Body mass index (BMI) between 18.5 and 25 ⁹	Adults		66% of men, 53% of women had a BMI above 25.	No

Methodology

10. *The nutritional health of the British population* (Section I) presents a detailed summary of findings from the four surveys in the NDNS programme carried out between 1992 and 2001. Results from the most recent NDNS of adults aged 19-64 years (NDNS 2000/01)⁴⁻⁸ are also compared with the 1986/87 Dietary and Nutritional Survey of British Adults aged 16-64 years¹⁹. This section highlights specific diet and nutritional issues according to age, gender, regional and socio-economic differences. The findings from the NDNS surveys 2000/01 and 1986/67 identify changes in the diet and nutritional health of the population over the last fifteen years.
11. *Analysis of the micronutrient intake of British adults* (Section II) reports secondary analysis of data from the recent NDNS of adults (2000/01)⁴⁻⁸. Three analyses were carried out:
 - a) Differences in dietary and non-dietary characteristics of those with low intakes/biochemical status compared to those with intakes/biochemical status at or above recommended thresholds. Nutrients for which there were sufficient numbers of people with low intakes/biochemical status to give meaningful results (≥ 100), were vitamins A, D and B₆, riboflavin (referred to as vitamin B₂), potassium and magnesium.

^{viii} Mean energy intakes fall below the EARs in all population groups although the number of obese individuals is increasing. This apparent paradox reflects under-reporting of intake and possibly overestimation of energy requirement for physical activity.

- b) This analysis considered all nutrients for which a relatively high proportionⁱ of adults had intakes below the LRNI (vitamin A, riboflavin, iron, calcium, magnesium, potassium, zinc, iodine) or low biochemical status (vitamins B₁, B₆ and B₁₂, riboflavin, vitamins C and D, folate and iron). Data were analysed by 5 equally sized groups (i.e. divided by quintiles) of the population grouped by intake/biochemical status for each nutrient. Differences in dietary and non-dietary characteristics between those with the lowest intakes/biochemical status (i.e. below quintile 1) and those with the highest (i.e. above quintile 4) were identified.
- c) Principal component analysis was used to characterise different patterns of food consumption and identify groups of individuals with similar dietary characteristics. The non-dietary characteristics of these groups were also investigated.

Main findings

Children aged 1½-18 years

Intakes failing to meet recommendations:

Fruit & vegetables

- 12. Children aged 4-18 years consumed less than the recommendation for people aged over 5 years ($\geq 400\text{g/day}$) with mean consumption between 70-190g/dayⁱⁱ. Twenty percent of children aged 4-18 years did not consume any fruit (excluding fruit juice) during the survey week.

Oily fish

- 13. All age groups consumed well below the recommendation (≥ 1 portion/wk) with mean consumption below 0.1 portion/wk.

Non-milk extrinsic sugar (NMES)

- 14. On average all age groups exceeded the recommendation ($\leq 11\%$ food energy), with mean intakes up to 19% of food energy; the main source of which was soft drinks.

ⁱ It is not possible to give a single precise figure above which the % was considered a "high proportion", due to the variability of nutrient intake/status across the age groups and sexes. Further detail of the proportion of adults with intakes below LRNI and biochemical status below indices markers can be found in section 2 of this report.

ⁱⁱ Not calculated using 5-a-day definition and includes fruit juice. There are currently no recommendations for weight of fruit and vegetable consumption for children under 5 years, due to smaller portion sizes.

Non-starch polysaccharides (NSP)

15. All age groups had mean intakes below the recommendation for adults (18g/day); a DRV has not been set for children. Mean intakes ranged from 6g/day for children aged under 5 years to 12g/day for children aged 15-18 years.

Alcohol

16. Boys and girls aged 15-18 years reported a mean alcohol consumption of 9 and 7 units of alcohol/week respectively.

Vitamins & mineralsⁱⁱⁱ

17. *Vitamin A*

- a) A tenth of children aged 1½-18 years had intakes below the LRNI.

18. *Vitamin D*

- a) Children aged under 5 years had a mean intake from food at 18% of the RNI.
b) 12% of children aged 11-18 years had low biochemical vitamin D status.

19. *Iron*

- a) 16% of children under 5 years and 47% of girls aged 11-18 years had iron intakes below the LRNI;
b) 20% and 21% respectively had low iron stores as indicated by serum ferritin concentrations below threshold levels;
c) 8% and 6% respectively were anaemic as indicated by haemoglobin concentrations below threshold levels;
d) A quarter of girls aged 11-18 years showed biochemical evidence of low iron status (transferrin saturation below 15%) (these data were not available for children under 4 years).

20. *Other Minerals*

- a) Large proportions of females aged 11-18 years had mineral intakes falling below the LRNI for magnesium (52%), potassium (28%), calcium (22%), zinc (24%) and iodine (12%).
b) Smaller proportions of males in this age group had intakes below the LRNI for magnesium (24%), potassium (12%), calcium (11%), zinc (12%) and iodine (2%).

ⁱⁱⁱ Thresholds of low biochemical vitamin D status :

Plasma 25-hydroxy vitamin D: <25nmol/L

Thresholds of low biochemical iron status :

Serum ferritin: 1½-4½yrs (male & female) <10µg/L, 7yrs+ male <20µg/L, 7yrs+ female <15µg/L.

Haemoglobin: 1½-6yrs (male & female) <11g/dl, 7yrs+ male <13 g/dl, 7yrs+ female <12 g/dl.

21. *Supplements*

- a) A fifth of children aged 1½-4½ years were reported to be taking non-prescribed supplements, mainly vitamins A, C and D and multivitamins^{iv}.

Young adults aged 19-24 years

Intakes failing to meet recommendations:

22. *Fruit & vegetables*

- a) Almost all (98%) of young adults aged 19-24 years consumed less than the recommendation (≥ 5 portions/day). Mean consumption was 1.6 portions/day.

23. *Non-milk extrinsic sugar (NMES)*

- a) Young adults aged 19-24 years exceeded the maximum recommendation ($\leq 11\%$ food energy) with mean intakes at 16% food energy from NMES.
- b) This age group reported drinking substantially more soft drinks (8-9 cans carbonated drink/wk) than in 1986/87 (3-4 cans carbonated drink/wk).

24. *Salt*

- a) Men and women aged 19-24 years were least likely of all the adult age groups to have intakes at or below the recommended maximum (≤ 6 g/day), with 98% and 83% respectively consuming more than 6g/day (estimated by urinary excretion).

25. *Non-starch polysaccharides (NSP)*

- a) Young adults aged 19-24 years had a mean intake (11g/day) below the recommended population average (18g/day).

26. *Vitamins & minerals^v*

- a) A large proportion of males and females aged between 11 and 25 years had intakes of vitamins and minerals below the LRNI, including vitamin A (15%), riboflavin (14%), iron (25%), potassium (21%) and magnesium (35%) compared to other groups.

^{iv} COMA recommended supplements of vitamins A and D should be given to children between the ages of one to five years, unless adequate vitamin status can be assured from a diverse diet containing vitamins A and D rich foods and from moderate exposure to sunlight^{vi}.

^v Thresholds of low biochemical vitamin D status:

Plasma 25-hydroxy vitamin D: < 25 nmol/l

Thresholds of low biochemical iron status:

Serum ferritin: 7yrs+ male < 20 µg/l, 7yrs+ female < 15 µg/l.

Haemoglobin: 7yrs+ male < 13 g/dl, 7yrs+ female < 12 g/dl.

27. *Vitamin D*

- a) 28% of women and 24% of men aged 19-24 years had low biochemical status for vitamin D.

28. *Iron*

- a) 42% of young women aged 19-24 years had iron intakes below the LRNI.
- b) 16% had low iron stores as indicated by serum ferritin concentrations below threshold levels;
- c) 7% were anaemic as indicated by haemoglobin concentrations below threshold levels;
- d) 27% showed biochemical evidence of low iron status (transferrin saturation below 15%).

Adults aged 19-64 years

Intakes failing to meet recommendations:

29. *Fruit & vegetables*

- a) Eighty-six percent of adults consumed less than the recommendation (≥ 5 portions/day). Mean consumption had increased by 0.4 portions/day to 2.8 portions/day compared to the previous survey.

30. *Oily fish*

- a) Adults consumed well below the recommendation (≥ 1 portion/wk) with a mean consumption of 0.3 portion/wk. Adults aged 50-64 years reported a higher consumption (mean 0.6 portion/week) in comparison to the previous survey in 1986/87 (mean 0.4 portion/wk).

31. *Non-milk extrinsic sugar (NMES)*

- b) Men and women exceeded the recommendation ($\leq 11\%$ food energy) with mean intakes at 14% and 12% food energy respectively.

32. *Salt*

- a) Adults' mean salt intakes increased to 9.5g/day from 9g/day in 1986/87, well above the recommended maximum of (≤ 6 g/day). Sodium intakes were estimated by urinary excretion in both surveys. A more recent survey of the same age group carried out in 2005/06 showed a small drop in mean intake to 9g/day²⁰.

33. *Non-starch polysaccharides (NSP)*

- a) Men and women had mean intakes (15g/day and 13g/day respectively) below the recommended population average (18g/day).

34. *Alcohol*

- a) 60% of men and 44% of women exceeded the recommended daily maximum for sensible drinking on at least one of the seven reporting days. Alcohol provided 6.5% and 3.9% of total energy on average for males and females aged 19-64 years respectively.

Vitamins & minerals^{vi}

35. *Iron*

- a) 41% and 27% of women aged 25-34 years and 35-49 years had iron intakes below the LRNI respectively.
- b) 8% and 12% respectively had low iron stores as indicated by serum ferritin concentrations below threshold levels;
- c) 8% and 10% respectively were anaemic as indicated by haemoglobin concentrations below threshold levels;
- d) 17% and 18% respectively showed biochemical evidence of low iron status (transferrin saturation below 15%).

36. *Vitamin D*

- a) low vitamin D status in 15% of the adult population overall

Intakes meeting recommendations:

37. *Fat*

- a) Adults consumed a lower proportion of food energy derived from total and saturated fat (35% and 13% respectively) compared to 1986/7 (40% and 17% respectively), accompanied by a reduction in total and LDL blood cholesterol levels.

^{vi} Thresholds of low biochemical iron status :
Serum ferritin: 7yrs+ male <20µg/L, 7yrs+ female <15µg/L.
Haemoglobin: 7yrs+ male <13 g/dL, 7yrs+ female <12 g/dL. .

38. *Red meat*

- a) Adults ate less red meat, processed meat and meat-based dishes (138g/day for men and 79g/day women) compared to 1986/87 (155g/day for men and 96g/day women).
- b) These figures include non-meat components of meat-based dishes and so are not comparable with recommendations for consumption of red and processed meat alone.^{vi} No analysis has been undertaken to make a direct comparison between consumption of red and processed meat and the COMA recommendation. However this decrease in mean consumption of red and processed meat and meat-based dishes is in line with the COMA recommendation to reduce the consumption of high consumers in order to reduce the risk of colo-rectal cancer¹². This needs to be balanced against the need to maintain the iron supply to reduce the risk of iron deficiency disease. A detailed analysis of the range of meat consumption levels and their contribution to iron intake has not been carried out for this report.

Women aged 50-64 years

39. This section of the population, compared to other population groups, was the closest to meeting current dietary recommendations. They ate the most fruit and vegetables (mean 3.8 portions/day) and oily fish (0.6 portion/week the same as men aged 50-64 yrs) compared to other population groups; had the lowest mean intake of salt (7.5g/day) in the adult aged 19-64 group and the highest mean intake of NSP (14g/day) amongst females.
40. This group also had the lowest mean intake of NMES (11% food energy) and total fat (34.5% food energy) compared to other population groups and the lowest mean intake of alcohol (2.7units/day) in the adult aged 19-64 group.

Analysis of micronutrient intakes and status

Analysis of non-dietary characteristics:

41. Adults with relatively low intakes of vitamin A, potassium and magnesium and adults with low biochemical riboflavin or vitamin D status were more likely to be smokers, to be living in households in receipt of benefits and to be younger.

^{vi} Consumption figures include non-meat components of meat-based dishes, so figures for consumption of red and processed meat and meat-based dishes are not directly comparable with recommendations for red and processed meat. Detailed recipe analysis of composite processed products would be required to calculate meat content alone.

42. Adults with low biochemical status for vitamin D were less physically active compared with those with biochemical vitamin D status above threshold levels.

Analysis of dietary characteristics:

43. Adults with relatively low nutrient intakes consumed less of almost all food groups except savoury snacks and soft drinks other than fruit juice.
44. Low biochemical riboflavin status was associated with drinking significantly less milk and eating significantly more savoury snacks and drinking significantly more soft drinks.
45. Low riboflavin and low biochemical vitamin D status were independently associated with eating fewer fish and fish dishes, and eating less total fruit and vegetables or fruit alone.

Analysis of dietary and non-dietary characteristics by quintile^{viii}:

46. Dietary patterns were identified similar to those observed above for analysis by DRV/status cut offs.
47. However, the association between low nutrient intake/status and higher consumption of soft drinks (excluding fruit juice) was not seen.
48. Adults who ate more sugar, preserves and confectionery had lower nutrient intake/biochemical status.
49. Adults with the lowest biochemical status for riboflavin, B12, vitamin C and folate ate the least breakfast cereals.

Analysis of consumption patterns:

50. Dietary and non-dietary patterns were observed in three distinct groups, identified in a statistical model which explained around a quarter of the variability in food consumption.
51. People in the group with the lowest mean intakes or biochemical status of all nutrients, except for iron, were more likely to be smokers, to live in households receiving benefits and to have had the highest consumption of soft drinks, savoury snacks and alcoholic beverages.

^{viii} The analysis by quintile identified some associations not seen in the analysis using DRV/status cut offs, due to varying sizes of the groups being compared, resulting from the different methodology used. The quintile analysis compared intakes/status of the highest quintile with the lowest quintile (each quintile is a fifth of the population sample), whereas the analysis using DRV/status cut offs compared those with intakes/status above the DRV/status threshold to those below the DRV/status threshold (the proportion of the population above and below certain thresholds was different for each variable, see main paper for details).

- 52. People in the group with the highest mean intakes or biochemical status of most nutrients were least likely to be smokers and ate the most fish and fish dishes, fruits and vegetables and nuts and seeds.
- 53. Adults taking non-prescribed supplements tended to be those with higher consumption of these micronutrients in food.

Adults aged 65 years and over

Intakes failing to meet recommendations:

- 54. *Fruit & vegetables*
 - a) Adults aged over 65 years consumed below the recommended 5 portions/day, both in the free-living group (mean intake 3 portions/day) and especially the institutional group (mean intake 2.1 portions/day).
- 55. *Oily fish*
 - a) Both the free-living and institutional groups consumed well below the recommendation (at least 1 portion/wk) with mean intakes <0.1 portion/wk.
- 56. *Non-starch polysaccharides (NSP)*
 - a) Both the free-living and institutional groups had mean intakes (12g/day & 10g/day respectively) below the recommendation (18g/day).

Vitamins & minerals^{ix}

- 57. *Vitamin D*
 - a) Both the free-living and institutional group had mean intakes at only 34% of the RNI.
 - b) 8% of the free-living group and 38% of the institutional group had low biochemical vitamin D status.
 - c) Plasma concentrations of 25-OH vitamin D were lower for men and women in the free-living group aged 65 years and over living in Scotland and the North compared to those living in other more southern regions. This was not accompanied by a significantly lower intake of vitamin D in Scotland and the North of England and so could be attributed to the reduced exposure to sunlight at higher latitude.

^{ix} Thresholds of low biochemical vitamin D status:
Plasma 25-hydroxy vitamin D: <25nmol/l
Thresholds of low biochemical iron status:
Serum ferritin: 7yrs+ male <20µg/l, 7yrs+ female <15µg/l.
Haemoglobin: 7yrs+ male <13 g/dl, 7yrs+ female <12 g/dl.

58. *Iron*

- a) 3% of the free-living group and 6% of the institutional group had iron intakes below the LRNI;
- b) 8% and 11% respectively had low iron stores as indicated by serum ferritin levels;
- c) 10% and 46% respectively were anaemic as indicated by haemoglobin concentrations below threshold levels;
- d) 11% and 28% respectively showed biochemical evidence of low iron status (transferrin saturation below 15%).

59. *Supplements*

- a) The proportion of older people reported, by interview, to be taking non-prescribed supplements was lower in the institutional group (8%) than in those living independently in the community (31%). The proportion of older people reported, by 4 day dietary record, to be taking vitamin D supplements (including prescribed supplements) was also lower in the institutional group (3%) than in those living independently in the community (16%)^{21x}.

Socio-economic status

60. There were marked differences in diet and nutritional status associated with socio-economic status. Fruit and vegetable consumption was lower in those living in benefit households and those from manual social class groups than those in other socio-economic groups. Both adults and children living in households in receipt of benefits were more likely to have intakes of vitamins and minerals below the LRNI compared to those living in households not receiving benefits. Low biochemical nutrient status was also seen in this group. Results of the UK Low-income diet and nutrition survey, published in 2007²², will help to understand and address the barriers to improving the quality and variety of diets of low-income groups.

Vitamin & mineral intake and biochemical status overview

61. Dietary intakes below the LRNI and low biochemical status were reported for several vitamins and minerals, especially in older children, young adults and older people, particularly those living in institutions.

^x COMA recommended vitamin D supplements for older adults who are housebound or living in institutions or who eat no meat or oily fish²⁷.

62. Low biochemical vitamin D status was observed in most age groups, but it was most noticeable in older children, young adults (including women of childbearing age) and older people living in institutions. The proportion of individuals with low biochemical vitamin D status in these groups increased in the winter months, the only exception being institutional elderly.
63. Biochemical vitamin D status was lower for free-living men and women aged 65 years and over living in Scotland and the North than in other regions of England and Wales at lower latitude; however there were no significant regional differences found for children or adults under 65 years.
64. Intakes below the LRNI and RNI were more frequently reported for minerals than vitamins.
65. Mean intakes of magnesium and potassium were below the RNI in all age groups except for children under 10 years.
66. Iron intake below the LRNI was found in young children, adolescent girls, women aged 19-34 years and women over 65 years. Low biochemical iron status was also seen in all of these groups as well as older men.

Conclusions

67. Although there have been positive changes in the diets of British adults over the last fifteen years (for example a fall in fat and saturated fat intakes, a reduction in the consumption of red meat, processed meat and meat-based dishes and an increase in fruit and vegetable consumption), there is still room for improvement. Specific population groups identified as most at risk of poor dietary variety and low nutrient intake and biochemical status were:
 - Children aged 18 years and under
 - Young adults aged 19-24 years
 - Smokers
 - People in lower socio-economic groups
 - Adults aged 65 years and over living in institutions
68. Several government initiatives seek to contribute to the reduction of obesity and improved diet and health of the nation (Annex 1). It is important to note that data collection for the most recent NDNS (2000/1) would not have

captured dietary changes which may have taken place following the relatively recent introduction of these initiatives (for example government reformulation work to reduce salt intakes did not begin until 2003).

69. The analyses detailed in this report confirm that improving the quality of the diets of children and young adults is an important area for investment. The rising prevalence of obesity coupled with low nutrient intakes and biochemical status in children and young adults suggests diets are too high in energy and sugar, but low in fruit and vegetable content, leading to poor vitamin and mineral status. Current policies addressing these issues include the promotion of fruit and vegetable consumption, and the nutritional improvement of school meals. The FSA is working with the food industry to reduce the salt, fat, saturated fat and energy content (including sugar) of many manufactured foods.

Current policy areas:

70. *Low fruit & vegetable consumption*
- Despite an encouraging increase in fruit and vegetable consumption it still remains below the recommendations in all age groups and is associated with low biochemical micronutrient status.
71. *High total/saturated fat intakes*
- The proportion of dietary energy derived from fat and saturated fat has decreased since the 1986/87 adults survey.
 - Mean intakes of total fat are close to recommendations in all population groups, though intakes of saturated fat exceed recommendations in all groups.
72. *High salt intakes.*
- Mean adult salt intake was higher in the 2000/01 than in 1986/87. A survey in 2005/06 showed a small fall in mean intake²⁰ but intakes remain well in excess of the 6g/day recommended maximum.
73. *Obesity*
- It would appear that mean energy intakes fell below the EARs in all population groups although the number of obese individuals is increasing. This apparent paradox reflects under-reporting of intake and possibly overestimation of energy requirements for physical activity.

Under-reporting would also affect intakes for other nutrients. Further research to characterise the diets of the obese and overweight groups would assist work to reduce of the prevalence of obesity.

74. *Specific “at risk” groups*

- Young adults, older adults living in institutions and people in lower socio-economic groups were identified as having a high prevalence of low nutrient intake and low biochemical status.

75. *Poor dietary patterns*

- The group with the lowest mean intakes and biochemical status of all nutrients (except iron) consumed more soft drinks, savoury snacks and alcoholic beverages.
- A higher consumption of sugar, preserves and confectionery was associated with low nutrient intake and biochemical status.

76. *High sugar-rich food consumption.*

- The proportion of energy intake derived from NMES exceeds the recommendation in most age groups, particularly amongst children and young adults, as well as older adults.
- Groups with the lowest mean intakes and biochemical status of almost all nutrients had the highest consumption of soft drinks.

77. *Low intake of non-starch polysaccharides*

- Intake of non-starch polysaccharides was low. No groups met the recommendation for adults.

78. *Low fish (especially oily fish) consumption.*

- Mean consumption of oily fish was below the recommendation in all age groups even though it has increased in certain groups over the past 15 years.
- The group with the highest consumption of fish and fish dishes had the highest mean intakes/biochemical status of most nutrients.

79. *Excessive alcohol consumption*

- A high proportion of men and women exceeded the recommended daily maximum intakes for alcohol consumption on at least one of the seven reporting days.
- The group with the lowest mean intakes/biochemical status of almost all nutrients out of the three groups had the highest consumption of alcoholic beverages.
- Alcohol provided 6.5% and 3.9% of total energy on average for males and females aged 19-64 years respectively.

80. *Biochemical Vitamin D status*

- Low biochemical vitamin D status was found in most population age groups, notably older children, young adults and older people living in institutions.

Recommendations

81. Improved monitoring of specific groups, particularly young adults, at risk of low nutritional status is required. Currently no national data are available to describe the nutritional status of pregnant women, black and ethnic minority groups or children aged under 18 months. These population groups along with older adults living in institutions and people (especially adults with children) in lower socio-economic groups could benefit from focused health initiatives.
82. Improvements to the quality and variety of the diet would help to address the imbalance in macronutrients and improve dietary fibre intake, as well as improving overall nutrient status. Sugar and saturated fat intake should be reduced, whilst increasing the intake of fats from oily fish, nuts and seeds etc. This is particularly important in institutions, where catering often tends to focus on the energy density of the diet rather than the quality.
83. Encouraging children to drink low fat milk^{xi} rather than soft drinks, would help to reduce sugar intakes and improve riboflavin and calcium intake.
84. Further promotion of diets rich in non-starch polysaccharides is needed to reduce the risk of bowel diseases.

^{xi} Semi-skimmed cow's milk is not suitable as a drink before the age of two years, but thereafter it may be introduced gradually if the child's energy and nutrient intake is otherwise adequate and growth remains satisfactory. Fully skimmed cow's milk should not be introduced before the age of five years²⁸

85. Encouraging people to eat more fish, particularly oily fish, would help to reduce the risk of cardiovascular disease.
86. Further action to discourage excessive alcohol consumption could help to improve the overall quality of the diet and would reduce the risk of liver disease and other alcohol-related illness. As alcohol contributes to total energy intake, a reduction in alcohol consumption would also help to reduce total calorie intake. There is also evidence that alcohol consumption increases the risk of a number of cancers²³.
87. COMA recommended vitamin D supplements for older adults who are either housebound or living in institutions and eating no meat or oily fish¹⁷, so in theory this is already being addressed; however this report identifies that supplement use was only reported by 7% of institutionalised older people. Further promotion of vitamin D rich foods (such as oily fish and eggs) and outdoor activity, as well as supplements for specific high risk groups, i.e. those with poor sunlight exposure (which includes dark-skinned ethnic minorities, people who cover their skin, young children and pregnant and breastfeeding women) especially during winter months, would increase vitamin D status and reduce the risk of disease related to vitamin D deficiency.
88. Dietary recommendations are made on a basis of sound scientifically proven associations between food or nutrient intake, status and various health outcomes. Results from the NDNS suggest that many UK health campaigns are effective as the quality of the diets in certain groups of the population is improving. However there are certain aspects of the UK diet which require specific attention in the context of current policy of disease prevention through dietary change (Annex 1). In general terms, the promotion of a balanced nutrient dense diet^{xii} and improvement in the quality and variety of the diet would contribute to better health and reduce the risk of nutrition-related ill-health and disease (such as obesity, diabetes, coronary heart disease, stroke, cancer and alcohol dependence). These initiatives should be set in the context of a healthy lifestyle, and reinforce existing measures to stop smoking, to maintain a healthy body weight and to take part in regular physical activity. Strategies to achieve behavioural change should be targeted particularly at young adults, older adults living in institutions and people in lower socio-economic groups.

^{xii} A balanced diet includes consuming plenty of fruit and vegetables, foods rich in starch and fibre such as bread, cereals and potatoes; consuming moderate amounts of meat, fish, eggs, nuts, beans, pulses, milk and dairy products (choosing reduced fat versions where possible); consuming food and drink high in saturated fat and sugar occasionally and if alcohol is consumed it is consumed sensibly²⁴.

2 Section I: The Nutritional Health of the British Population

Summary

89. This Section brings together evidence relating to the nutritional health of the population in Great Britain. The current situation is described using data from the National Diet and Nutrition Surveys (NDNS), while changes in the adult population are highlighted by comparison of results from the NDNS in 2000/01 with the comparable survey in 1986/87.
90. Although there is some evidence of positive dietary changes in the population, especially lower intakes of fat and saturated fat in the 2000/01 NDNS compared with the 1986/87 adults survey, the findings from surveys of these and other age groups highlight a number of areas for concern. Consumption of fruit and vegetables is below the recommendation in all age groups, and is particularly low for young adults and people in lower socio-economic groups. There is evidence of low intakes and status for a number of vitamins and minerals especially for older children, young adults and older people living in institutions. The proportion of energy intake derived from non-milk extrinsic sugar (NMES) exceeds the recommendation in most age groups, particularly for children and young adults. There is also evidence of marked differences in diet and nutritional status associated with socio-economic status. These findings indicate a need to improve the balance of the diet for the population as a whole with the focus on children and young adults.

Background

91. This section presents an overview of the nutritional health of the population based on data from the four surveys in the National Diet and Nutrition Survey programme (NDNS) carried out between 1992 and 2001.¹⁻⁸ Results from the most recent NDNS of adults aged 19-64 years⁴⁻⁸ (2000/01) are also compared with the 1986/87 Dietary and Nutritional Survey of British Adults aged 16-64 years¹⁹.
92. Specific diet and nutritional issues in different age groups are highlighted and regional and socio-economic differences are discussed. Differences highlighted in the commentary are statistically significant unless otherwise indicated.

93. The NDNS in its original form, was a series of cross-sectional surveys of different population age groups. It aims to provide a comprehensive picture of the dietary habits and nutritional status of the population of Great Britain. The original programme was split into four separate surveys. Each survey has examined a nationally representative sample drawn from four different population age groups: children aged 1½-4½ years¹ (fieldwork 1992/93), young people aged 4-18 years³ (1997), adults aged 19-64 years⁴⁻⁸ (2000/01) and people aged 65 years and over² (1994/95). Each survey collected detailed quantitative information on food consumption and nutrient intake, physical measurements, nutritional status indices and socio-economic, demographic and lifestyle characteristics.
94. The NDNS programme covers the British population aged 1½ years upwards living in private households. The survey of people aged 65 years and over also included a sample of people living in residential and nursing homes. The NDNS programme does not cover infants and children aged under 18 months, pregnant and lactating women or people living in institutions such as prisons, schools, hospitals and care homes.
95. The surveys in the NDNS programme were designed to be representative of the British population within the specified age group. The sample size for each survey permits a more detailed analysis by age and sex but does not allow for separate analysis of specific population sub-groups such as ethnic minority groups, vegetarians etc. In interpreting the data it should be borne in mind that the surveys have been carried out over a 15 year period and so secular trends may confound apparent differences between survey age groups.
96. The methodologies used for collecting food consumption data are comparable between surveys. The analytical methods used for nutritional status measures are also generally comparable between surveys, with the exception of the 1986/87 adults survey which used different analytical methods and/or laboratories for many measures.
97. Mis-reporting of food consumption in dietary surveys, generally under-reporting, is known to be a problem in NDNS as in dietary surveys worldwide.^{4,25} Under-reporting can cause biased low estimates of intake as respondents under-report their actual intake or modify their diet during the recording period. The level of under-reporting needs to be borne in mind when interpreting findings from dietary surveys, for example in comparing intakes with recommendations. Analysis of data from the NDNS adults 2000/01 indicated that energy intake was under-reported to a level of 25% of energy needs on average. It is not

possible to ascertain whether under-reporting was higher in this survey than in the 1986/87 survey because there was no assessment of physical activity or energy expenditure in the earlier survey. Doubly labelled water studies suggest similar levels of under-reporting for other age groups except for pre-school children where levels were lower. There is evidence that under-reporting is selective – fatty, sugary and snack foods and alcohol are more likely to be under-reported than are other foods such as fruit and vegetables. However the level of under-reporting for specific macro and micronutrients is not known.

98. The nutrient intake data presented in this report have not been adjusted for under-reporting. Associations should be interpreted with caution due to under-reporting of food consumption.
99. Following a review of the Food Standards Agency's dietary survey programme in 2002/03²⁶ the Agency's Board has agreed to move to a rolling programme format for future NDNS, whereby the survey runs continuously and fieldwork is carried out every year. This new approach will strengthen the ability to track trends over time and give more flexibility to respond to policy needs. Fieldwork for the NDNS rolling programme began in 2008 following development work.

Diet and nutritional status in the population

100. This section sets out findings under the headings of dietary habits, energy and macronutrient intakes, micronutrient intakes and nutritional status, and oral health, focusing on the following age groups: adults, older adults (including free-living and institution groups), children and young people.
101. Throughout the section, nutrient intakes are compared with COMA Dietary Reference Values⁹ and other COMA and SACN recommendations^{27,28}. Dietary Reference Values (DRV) for total fat, saturated and trans fatty acids and non-milk extrinsic sugars are the recommended *maximum* contribution these nutrients should make to the population average diet, expressed as percentage of energy intake. For total carbohydrate, cis monounsaturated fatty acids and non-starch polysaccharide (NSP), the DRVs are population *averages*, i.e. the average contribution, as a percentage of energy, that total carbohydrate and cis monounsaturated fatty acids should make and the average intake of NSP in grams per day. For energy the DRV is the Estimated Average Requirement (EAR), that is the intake that meets the energy requirement of 50% of the population group. Finally, DRVs for protein, vitamins and minerals are expressed as Lower Reference Nutrient Intakes (LRNI) (not protein) and Reference Nutrient

Intakes (RNI), the intakes at which the requirements of 2.5% and 97.5% of the population group are met. Mean intakes *at or above* the RNI for these nutrients are desirable. It is important to note, therefore, that to 'meet the DRV' can mean that intake of that nutrient is at or below the DRV (e.g. trans fatty acids) or that intake is at or above the DRV (e.g. NSP). Nutritional status indices are compared with published threshold values.

Dietary habits

102. This section considers findings for consumption of fruit and vegetables, oily fish, meat and meat products, soft drinks and dietary supplements and compares dietary habits in adults between the 1986/87 and 2000/01 surveys. Consumption of fruit and vegetables and oily fish are compared with Government recommendations.

Adults

Fruit and vegetablesⁱ (Tables 2 & 3; Figure 1)

103. In the most recent NDNS (2000/01) the average consumption of fruit and vegetables for adults aged 19-64 years was 2.7 portions per day for men and 2.9 portions for women, calculated based on the definition used in the five-a-day programmeⁱⁱ (Table 2). Seventeen percent of adults ate less than one portion of fruit and vegetables a day, while 13% of men and 15% of women met the five-a-day target. Mean consumption increased with age for both men and women but was below the five-a-day recommendation in all age groups. Mean consumption was lowest in the 19-24 group at 1.3 portions per day for men and 1.8 portions for women.
104. Comparing the consumption of fruit and vegetables by adults in the 1986/87 and 2000/01 surveysⁱⁱⁱ consumption was higher in 2000/01 by 140 grams/week on average for men and 280g/week for women. The greatest difference in consumption was in the 50-64 age group which was over 450g/week higher for both men and women in 2000/01 compared with 1986/87. In young adults (19-24 years) there was no evidence of an increase in consumption and in men aged 19-34 years the data suggest lower consumption in 2000/01 although the difference did not reach statistical significance (Table 3).

ⁱ Includes fruit juice

ⁱⁱ The definition of fruit and vegetable consumption used in the NDNS used for comparison with the five-a-day recommendation is: daily consumption of fruit and vegetables (excluding potatoes), including those in selected composite dishes (fruit pies and vegetable dishes), and including all fruit juice consumed as one portion only, and similarly all baked beans and other pulses consumed as one portion only.

ⁱⁱⁱ Comparison of fruit and vegetable consumption in the 1986/87 and 2000/01 surveys is not based on the 5-a-day definition as this analysis is not available for the 1986/87 survey.

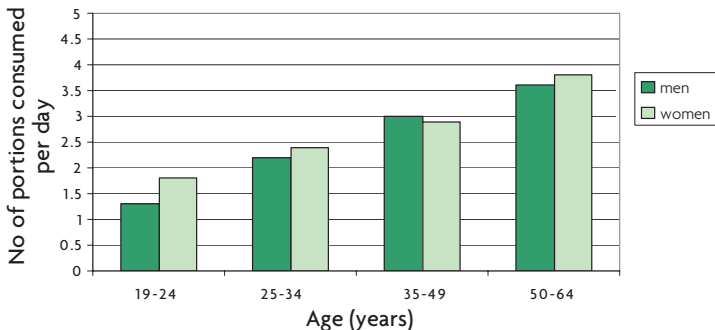
Oily fish (Table 4; Figure 2)

105. Mean consumption of oily fish (excluding canned tuna)^{iv} in the 2000/01 adults survey was just over a third of a portion^v per week, below the recommendation of one portion per week. Mean consumption increased with age from around 0.1 portions per week in the 19-24 age group to 0.6 portions per week in the 50-64 year age group. Consumption in the 50-64 group was higher in 2000/01 compared to 1986/87 for both men and women but this difference was not seen in the 19-24 group (Table 4).

Meat, meat products and dishes (Tables 5a & b)

106. Mean consumption of meat, meat products and dishes as a group was higher for men in 2000/01 (200g/day) compared with 1986/87 (183g/day). There was no significant difference for women. Mean consumption of liver (including products and dishes), meat pies and pastries and “other” meat and meat products was lower in 2000/01 than in 1986/87, for both men and women, whereas consumption of coated chicken & turkey, chicken and turkey dishes and, for men only, burgers and kebabs was higher in 2000/01 than in 1986/87. Chicken and turkey was the most commonly consumed type of meat in 2000/01 for both men and women whereas in 1986/87 the most commonly consumed type was beef and veal.

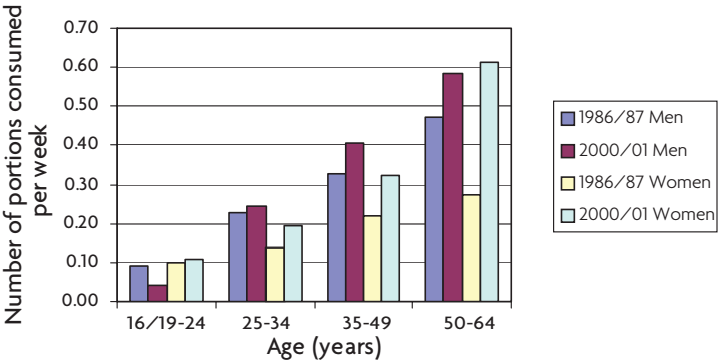
Figure 1. Mean number of portions of fruit and vegetables consumed per day (based on five-a-day definition) by adults in 2000/01



^{iv} canned tuna is not included in the definition of an oily fish, as processing of tuna during the canning process reduces the fat content of the fish to a low level.

^v A portion of oily fish is defined as around 140grams.

Figure 2: Comparison of average number of portions of oily fish (excluding canned tuna) consumed per week between 1986/87 and 2000/01



107. COMA recommended in its 1998 report on nutritional aspects of cancer that average consumption of red and processed meat should not increase from the then current average of 90g/day¹². The data show that consumption of red and processed meat and meat-based dishes (that is excluding chicken and turkey and dishes) was lower in 2000/01 than in 1986/87 for both men (138g/day in 2000/01) and women (79g/day in 2000/01)^{vi}. Although the data from the NDNS are not directly comparable with the recommendation the lower consumption of red and processed meat and meat based dishes in the most recent survey suggests that the trend in consumption is in the direction of the recommendation.

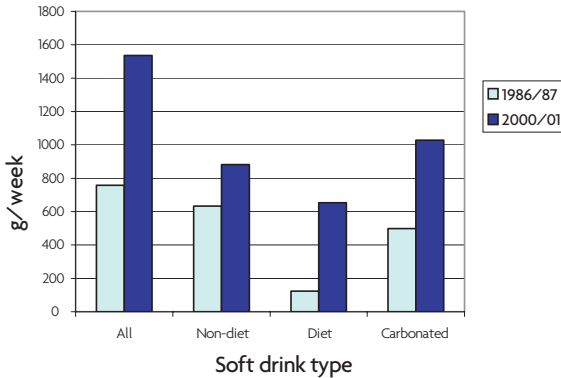
Soft drinks (Tables 6a & b; Figure 3)

108. Consumption of soft drinks in adults was substantially higher in 2000/01 than in 1986/87. Mean consumption levels in 2000/01 were equivalent to 4-5 cans per week, compared to less than 3 cans per week in 1986/87. The majority of soft drinks consumed were carbonated. Women consumed similar amounts of diet and non-diet varieties on average while men consumed more of the

^{vi} Consumption figures include non-meat components of meat-based dishes and so are not directly comparable with the COMA recommendation.

non-diet type. In 2000/01 young men and women (19-24 years) consumed over three times the quantity of soft drinks as did the oldest men and women (50-64 years).

Figure 3: Mean consumption of soft drinks by adults in 1986/87 and 2000/01



Dietary supplements

109. Forty percent of women and 29% of men overall in the 2000/01 adults survey reported taking dietary supplements in the survey week. This compared with 17% of women and 9% of men in 1986/87. Use of supplements increased with age to 55% of women in the 50-64 age group. Cod liver oil and other fish oil based supplements and multi-vitamins and multi-minerals were the most commonly used types of supplements in this age group.

Older adults aged 65 and over

Fruit and vegetables group (Table 7)

110. Mean fruit and vegetable consumption^{vii} in the free-living group aged 65 and over was slightly lower than in the adult population at 244 and 230g/day for men and women respectively, the difference being due to lower consumption of vegetables and fruit juice. In the institution group mean consumption was substantially lower than in the free-living group at 171 and 163g/day in total for men and women respectively.

^{vii} consumption estimates not based on the 5-a-day definition. Includes fruit juice

Oily fish (Table 8)

111. Mean consumption of oily fish (excluding canned tuna) in the free-living group was substantially higher than that in the adult population for men at 85g/week, but similar for women at 47g/week. Older adults living in institutions had a lower average oily fish consumption than their free-living counterparts at around 28g/week for men and women. Data on this age group was collected in the mid-1990s and oily fish like salmon has become cheaper and more available since then.

Meat, meat products and dishes (Table 9)

112. Mean consumption of meat, meat products and dishes in the free-living group aged 65 and over was lower than in the 50-64 age group, at 128g/day and 98g/day for men and women respectively. Mean consumption in the institution group was lower than in the free-living group. Beef, veal and dishes were the most commonly consumed type of meat in both the free-living and institution groups.

Soft drinks (Table 11)

113. Consumption of soft drinks by older adults was lower than in the 19-64 age group. Mean consumption was 347 and 322g/week for men and women respectively in the free-living group (equivalent to about 1 can per week). Non-diet concentrated squashes and carbonates were the most commonly consumed types. Consumption in the institution group was over twice that in the free-living group at about 850g/week, largely due to high consumption of non-diet fruit squashes in this group.

Dietary supplements

114. In older people aged 65 and over, 28% of men and 34% of women in the free-living group reported taking supplements, most commonly cod-liver oil based. In the institution group the proportion that reported taking supplements was much lower – 5% of men and 9% of women. Use of vitamin D supplements, for example, was reported by 3% of the institution group and 16% of the free-living group²¹.

Children and young people aged 1½-18 years

Fruit and vegetables (Table 7)

115. Mean consumption of fruit and vegetables^{viii} in the 4-18 year group was around 170-190 grams/day in the 4-6, 7-10 and 11-14 age groups and around 200g/day in the 15-18 age group. Twenty percent of the 4-18 age group did not consume any fruit (excluding fruit juice) during the survey week and 4% consumed no vegetables. Mean consumption in the 1½-4½ year group was 126 grams/day.

Oily fish (Table 8)

116. Consumption of oily fish (excluding canned tuna) was less than 0.1 portions (5-10 grams) per week in all age groups.

Meat, meat products and dishes (Table 10)

117. Mean consumption of meat, meat products and dishes was 52g/day in the 1½-4½ year age group. Beef, veal and dishes were the most commonly consumed type providing about a quarter of consumption, followed by sausages. In the 4-18 year age group mean consumption of meat, meat products and dishes in boys aged 15-18 was more than double that in the 4-6 year group. There was a less marked difference with age in girls. Chicken and turkey dishes was the main type of meat consumed in all age/sex groups but the contribution of beef, veal and dishes, bacon and ham, burgers and kebabs was substantially higher in the 15-18 year old boys compared to other age groups.

Soft drinks (Table 11)

118. Consumption of soft drinks in the 1½-4½ year age group was 2.8 litres/week, equivalent to about 8 cans or 14 cartons. Concentrated squashes were the main type of soft drink consumed by this age group. In older children mean consumption was over 3 litres per week in the 7-10 year age group and over 3.5 litres/week for 11-18 year old boys. Consumption in girls in the same age group was slightly lower at around 2.6 litres/week. Non-diet carbonated drinks were the main type of soft drink consumed in the 11-18 age group.
119. There is no earlier comparable national survey of this age group from which to assess trends in soft drink consumption. However two comparable studies of 11-12 year olds in Northumberland carried out in 1980 and 2000²⁸ show that carbonated soft drink consumption in this group was 2½ times higher in 2000

^{viii} Consumption estimates not based on 5-a-day definition. Includes fruit juice.

(191g/day; 1337g/week) than in 1980 (78g/day; 546g/week)^x. These studies also showed an inverse relationship between consumption of soft drinks and of milk. The consumption data from 2000 for carbonated drinks are similar to the NDNS data collected in 1997 for the 11-14 year age group (1865g/week for boys and 1507g/week for girls).

Dietary supplements

120. In children aged 1½-4½ years, surveyed in 1992, a fifth of this age group reported taking supplements, mainly vitamins A, C and D and multivitamins. In the later survey of the 4-18 year age group in 1997 a fifth of this group overall reported using supplements. Reported usage was 32% and 23% of boys and girls in the 4-6 age group and 13% and 22% of boys and girls in the 15-18 age group.

Overview of dietary habits

121. Mean consumption of fruit and vegetables (including fruit juice) was below the five-a-day target in all age groups. There was evidence of higher consumption in the 50-64 age group compared with 1986/87 but there was no evidence of this for the youngest group (19-24 years); the data suggested that consumption by young men was slightly lower in the more recent survey. Mean consumption of oily fish was below the recommended level of one portion per week in all age groups. Again there was some evidence of higher consumption in adults (particularly women) aged 50-64 years in 2000/01 compared with 1986/87 but not in the 19-24 year group. Consumption of soft drinks in the 19-64 age group in the more recent survey was substantially higher than in 1986/87, mainly due to higher consumption of carbonated drinks. Mean consumption of meat, meat products and dishes was slightly higher for men but not women in 2000/01 compared with 1986/87 though when chicken and turkey were excluded consumption was slightly lower for both men and women. Consumption of chicken and turkey dishes in 2000/01 was double that in 1986/87 for men and women while consumption of liver, meat pies and 'other' meat and products was lower in the more recent survey. Over a third of adults reported taking dietary supplements in the most recent survey.

^x Data from this study for total soft drink consumption are not comparable with NDNS data. Total soft drink consumption in this study was 109g/day (763g/week) in 1980 and 291g/day (2047 g/week) in 2000/01.

Table 2: Consumption of fruit and vegetables (using five-a-day definition*) by adults aged 19-64 years (portions** per day)

Cumulative percentages														
Average daily number of portions of fruit and vegetables consumed	Men aged (years):				All men	Women aged (years):				All women	All			
	19-24	25-34	35-49	50-64		19-24	25-34	35-49	50-64					
	cum %	cum %	cum %	cum %		cum %	cum %	cum %	cum %					
None	6	1	0	1	1	2	1	1	0	1	1			
Less than 1 portion	38	27	14	7	18	36	19	16	7	16	17			
Less than 2 portions	86	54	36	29	45	64	46	41	20	39	42			
Less than 3 portions	95	76	59	45	64	83	71	61	44	61	62			
Less than 4 portions	95	86	75	60	76	96	82	73	60	74	75			
Less than 5 portions	100	93	86	76	87	96	91	83	78	85	86			
Number of subjects (unweighted)	61	160	303	242	766	78	211	379	290	958	1724			
Mean number of portions consumed (average value)	1.3	2.2	3.0	3.6	2.7	1.8	2.4	2.9	3.8	2.9	2.8			

* The definition of fruit and vegetable consumption used for the five-a-day programme is: daily consumption of fruit and vegetables, including those in selected composite dishes (fruit pies and vegetable dishes), and including all fruit juice consumed as one portion only, and similarly all baked beans and other pulses consumed as one portion only

** 1 portion = 80 grams

Table 3: Consumption of fruit and vegetables* by adults in 1986/87 and 2000/01 (grams per week)

Mean consumption g/week	1986/87 Adults Survey Men aged:					2000/01 NDNS Men aged:				
	16-24	25-34	35-49	50-64	All	19-24	25-34	35-49	50-64	All
Vegetables (excluding potatoes)	832	1000	1139	1137	1046	665	854	1006	1135	961
Fruit	253	430	504	596	460	190	428	694	855	607
Fruit Juice	313	322	233	181	257	264	258	393	385	339
Total (Vegetables, Fruit, Fruit juice)	1398	1752	1876	1914	1763	1119	1540	2093	2375	1907
Number of subjects (unweighted)	214	254	346	273	1087	61	160	303	242	766

Table 3 (continued): Consumption of fruit and vegetables* by adults in 1986/87 and 2000/01 (grams per week)

Mean consumption g/week	1986/87 Adults Survey Women aged:					2000/01 NDNS Women aged:				
	16-24	25-34	35-49	50-64	All	19-24	25-34	35-49	50-64	All
Vegetables (excluding potatoes)	700	828	905	965	868	626	911	970	1004	926
Fruit	371	419	580	709	540	379	521	687	1060	720
Fruit Juice	311	312	259	259	280	353	316	301	358	327
Total (Vegetables, Fruit, Fruit juice)	1382	1559	1744	1933	1684	1358	1748	1958	2422	1973
Number of subjects (unweighted)	189	253	385	283	1110	78	211	379	290	958

* Not calculated using 5-a-day definition. May include more than one portion of fruit juice and more than one portion of beans/pulses.

Table 4: Consumption of oily fish* per week in adults in 1986/87 and 2000/01

Gender and age	1986/87			2000/01		
	Mean (g/week)*	Number of portions**	Number of subjects (unweighted)	Mean (g/week)*	Number of portions**	Number of subjects (unweighted)
Male aged (years)						
19-24	12	0.1	134	5	< 0.1	61
25-34	34	0.2	254	32	0.2	160
35-49	49	0.3	346	56	0.4	303
50-64	66	0.5	273	80	0.6	242
All (19-64 years)	45	0.3	1007	51	0.4	766
Female aged (years)						
19-24	20	0.1	119	14	0.1	78
25-34	19	0.1	253	28	0.2	211
35-49	33	0.2	385	46	0.3	379
50-64	38	0.3	283	88	0.6	290
All (19-64 years)	29	0.2	1040	50	0.4	958

* Excludes canned tuna. Includes recipe dishes

** One portion = 140 grams

Table 5a: Consumption of meat, meat products and dishes¹ by men in 1986/7 and 2000/01 (grams per day)

Men aged (years)	1986/87 Adults Survey					2000/01 NDNS				
	16-24	25-34	35-49	50-64	All	19-24	25-34	35-49	50-64	All
g/week	Mean (g)	Mean (g)	Mean (g)	Mean (g)	Mean (g)	Mean (g)	Mean (g)	Mean (g)	Mean (g)	Mean (g)
Bacon & ham	19	17	19	23	20	18	18	19	22	20
Beef, veal & dishes	37	52	46	39	44	45	43	43	40	42
Lamb & dishes	10	10	9	14	10	6	10	8	9	9
Pork & dishes	10	14	11	13	12	6	10	12	14	11
Coated chicken & turkey	2	3	2	1	2	12	9	8	3	7
Chicken & turkey dishes	28	29	26	22	26	49	58	60	48	54
Liver & liver products & dishes	2	4	5	5	4	0	2	3	3	2
Burgers & kebabs	18	12	5	3	9	27	18	10	2	12
Sausages	17	14	13	12	14	17	14	14	11	13
Meat pies & pastries	38	25	23	19	25	19	20	20	21	20
Other meat & meat products*	18	7	16	17	17	5	7	8	11	8
Total meat, meat products & dishes**	198	195	176	168	183	205	209	205	184	200
Number of subjects	214	254	254	273	1087	61	160	303	242	766

¹ Consumption data includes non-meat components of meat-based dishes

* Includes game, duck, goose, all offal (except liver), black pudding, corned beef, salami etc.

** Sum of individual food groups may not equal total consumption of meat, meat products & dishes due to rounding.

Table 5b: Consumption of meat, meat products and dishes¹ by women in 1986/7 and 2000/01 (grams per day)

Females aged (years)	1986/87 Adults Survey					2000/01 NDNS				
	16-24	25-34	35-49	50-64	All	19-24	25-34	35-49	50-64	All
g/week	Mean (g)	Mean (g)	Mean (g)	Mean (g)	Mean (g)	Mean (g)	Mean (g)	Mean (g)	Mean (g)	Mean (g)
Bacon & ham	10	11	12	14	12	9	10	11	12	11
Beef, veal & dishes	29	32	31	26	30	33	25	31	30	29
Lamb & dishes	7	5	7	9	7	4	4	6	7	6
Pork & dishes	8	8	7	8	7	5	6	8	7	7
Coated chicken & turkey	3	2	2	1	2	11	6	7	3	6
Chicken & turkey dishes	17	18	22	18	19	38	39	43	36	39
Liver & liver products & dishes	3	3	5	5	4	0	1	1	1	1
Burgers & kebabs	10	7	5	2	5	15	7	5	2	6
Sausages	8	8	7	7	8	8	7	6	5	6
Meat pies & pastries	15	13	13	12	13	9	8	10	9	9
Other meat & meat products*	11	10	11	9	10	3	2	4	6	4
Total meat, meat products & dishes**	120	117	122	110	117	136	115	131	119	124
Number of subjects	189	253	385	283	1110	78	211	379	290	958

¹ Consumption data includes non-meat components of meat-based dishes

* Includes game, duck, goose, all offal (except liver), black pudding, corned beef, salami etc.

** Sum of individual food groups may not equal total consumption of meat, meat products & dishes due to rounding.

Men aged (yrs)	1986/87 Adults Survey										2000/01 NDNS									
	16-24		25-34		35-49		50-64		19-24		25-34		35-49		50-64					
	Mean ¹	% cons-umers ²	Mean	% cons-umers	Mean	% cons-umers	Mean ¹	% cons-umers	Mean	% cons-umers	Mean	% cons-umers	Mean	% cons-umers	Mean	% cons-umers				
Non diet soft drinks <i>Of which:</i>	1380	75	766	71	513	57	308	49	2,662	94	1336	79	766	58	478	44				
Non diet RTD	146	23	72	16	58	12	67	11	163	24	65	14	50	11	50	9				
Non diet concentrates*	404	24	162	20	131	16	72	15	436	25	324	30	275	22	184	15				
Non diet carbonates	830	66	532	57	324	45	169	36	2,063	92	946	64	441	44	243	33				
Diet soft drinks <i>Of which:</i>	73	9	150	14	83	12	70	8	565	34	837	40	612	40	388	26				
Low calorie RTD	7	1	1	1	2	1	0	0	—	—	2	0	4	1	10	1				
Low calorie concentrates*	13	2	30	2	12	2	25	2	240	12	278	15	232	15	137	9				
Low calorie carbonates	53	7	119	11	68	10	45	7	325	26	557	30	376	30	242	22				
Total soft drinks**	1453	77	915	73	595	60	379	54	3227	96	2182	89	1377	72	866	58				
Number of subjects (unweighted)	134		254		346		273		61		160		303		242					

RTD = ready to drink

Table 6b: Consumption of soft drinks by women in 1986/87 and 2000/01 (grams per week)

Females aged (years)	1986/87 Adults Survey								2000/01 NDNS							
	16-24		25-34		35-49		50-64		19-24		25-34		35-49		50-64	
	Mean ⁱ (g)	% cons- umers ⁱⁱ	Mean (g)	% cons- umers	Mean (g)	% cons- umers	Mean (g)	% cons- umers	Mean (g)	% cons- umers	Mean (g)	% cons- umers	Mean (g)	% cons- umers	Mean (g)	% cons- umers
Non diet soft drinks	1033	84	652	69	439	59	241	48	1705	78	771	63	560	54	416	44
<i>Of which:</i>																
Non diet RTD	115	24	85	17	55	14	45	10	102	20	92	15	95	13	72	11
Non diet concentrates*	202	35	140	27	139	24	76	16	409	38	258	23	144	20	114	14
Non diet carbonates	716	72	427	58	245	46	120	36	1194	64	421	47	321	38	230	32
Diet soft drinks	168	24	194	20	159	20	75	14	1002	53	1185	58	555	38	379	32
<i>Of which:</i>																
Low calorie RTD	6	3	3	1	3	1	0	0	8	4	10	2	11	3	4	2
Low calorie concentrates*	1	1	19	3	6	1	45	5	195	27	284	19	111	9	95	8
Low calorie carbonates	161	21	171	17	150	19	30	11	800	35	892	50	433	34	281	26
Total soft drinks**	1201	89	846	75	598	66	317	56	2728	97	1960	86	1121	71	797	62
<i>Number of subjects (unweighted)</i>	119		253		385		283		78		211		379		290	

* Includes water used as a diluent

** Sum of individual soft drink groups may not equal total consumption of soft drinks due to rounding.

†† consumers = percentage of the age group who reported consuming in the seven-day dietary assessment period

‡ Mean values include non-consumers

RTD = ready to drink

Table 7: Mean vegetable, fruit and fruit juice consumption (grams per day)

Population group	Vegetables	Fruit	Fruit Juice	Total fruit, vegetables and fruit juice*	Number of subjects (unweighted)
	g/day	g/day	g/day	g/day	
Males & Females 1.5-4.5 years	39	50	37	126	1675
Males aged (years):					
4-6	60	63	44	167	184
7-10	58	62	54	174	256
11-14	73	42	55	170	237
15-18	94	44	62	200	179
19-64	137	87	48	273	766
65+ <i>Free-living</i>	123	97	24	244	632
65+ <i>Living in an institution</i>	102	60	9	171	204
Females aged (years):					
4-6	58	65	49	172	171
7-10	69	68	53	190	226
11-14	70	48	53	171	238
15-18	101	54	61	216	210
19-64	132	103	47	282	958
65+ <i>Free-living</i>	109	96	25	230	643
65+ <i>Living in an institution</i>	83	61	19	163	208

* Not calculated using 5-a-day definition. May include more than one portion of fruit juice and more than one portion of beans/pulses

Table 8: Average consumption of oily fish* per week

Gender and age	Mean (g)*	Number of portions**	Number of subjects (unweighted)
Males and females aged 1.5-4.5 years	5	<0.1	1675
Males aged (years):			
4-6	6	<0.1	184
7-10	5	<0.1	256
11-14	10	<0.1	237
15-18	10	<0.1	179
19-64	51	0.4	766
65+ <i>Free-living</i>	85	0.6	632
65+ <i>Living in an institution</i>	29	0.2	204
Females aged (years):			
4-6	7	<0.1	171
7-10	8	<0.1	226
11-14	5	<0.1	238
15-18	7	<0.1	208
19-64	50	0.4	958
65+ <i>Free-living</i>	47	0.3	643
65+ <i>Living in an institution</i>	28	0.2	208

* Excludes canned tuna. Includes recipe dishes

** One portion is about 140g

Table 9: Consumption of meat, meat products and dishes¹ by adults aged 65 years and over (grams per day)

	65+ Free-living			65+ Living in an Institution		
	Males	Females	All	Males	Females	All
Type of Meat in g/week	Mean (g)	Mean (g)	Mean (g)	Mean (g)	Mean (g)	Mean (g)
Bacon & ham	17	12	14	12	9	10
Beef, veal & dishes	31	26	28	29	23	24
Lamb & dishes	9	6	7	8	7	7
Pork & dishes	9	7	8	6	4	4
Coated chicken & turkey	1	1	1	1	1	1
Chicken & turkey dishes	20	18	19	11	9	10
Liver & liver products & dishes	3	2	3	1	1	1
Burgers & kebabs	2	2	2	1	1	1
Sausages	8	6	7	8	5	5
Meat pies & pastries	20	12	16	16	12	13
Other meat products*	9	5	6	10	8	8
Total meat, meat products & dishes	128	98	110	104	80	85
Number of subjects (unweighted)	632	643	1275	204	208	412

* Consumption data includes non-meat components of meat-based dishes . . .

* Includes game, duck, goose, all offal (except liver), black pudding, corned beef, salami etc

Table 10: Consumption of meat, meat products and dishes¹ by children and young people aged 4 to 18 years (grams per day)

	Males & females aged 1.5 to 4.5 years		Males aged 4 to 18 years					Females aged 4 to 18 years				
	Mean (g)	1.5-4.5	4-6	7-10	11-14	15-18	All	4-6	7-10	11-14	15-18	All
Type of Meat in g/week	Mean (g)		Mean (g)	Mean (g)	Mean (g)	Mean (g)	Mean (g)	Mean (g)	Mean (g)	Mean (g)	Mean (g)	Mean (g)
Bacon & ham	3	6	7	11	15	10	6	8	7	7	7	7
Beef, veal & dishes	12	12	16	17	33	20	10	18	20	21	21	18
Lamb & dishes	2	5	8	10	11	9	4	7	6	5	6	6
Pork & dishes	2	4	5	7	8	6	3	5	5	7	7	5
Pork & dishes	3	9	10	9	13	10	9	10	11	13	13	11
Chicken & turkey dishes	7	14	17	28	39	25	16	19	23	27	27	21
Liver & liver products & dishes	0	0	0	0	1	0	0	0	0	0	0	0
Burgers & kebabs	3	5	6	11	20	11	5	6	9	10	10	7
Sausages	9	14	14	12	17	14	9	11	10	7	7	9
Meat pies & pastries	6	9	10	15	18	13	7	10	11	10	10	10
Other meat & meat products*	4	4	2	5	5	4	2	4	3	3	3	3
Total meat, meat products & dishes	52	81	96	126	180	122	71	97	105	110	110	97
Number of subjects (unweighted)	1675	184	256	237	179	856	171	226	238	210	210	845

¹ Consumption data includes non-meat components of meat-based dishes

* Includes game, duck, goose, all offal (except liver), black pudding, corned beef, salami etc.

Table 11: Mean consumption of soft drinks (grams per week)

Consumption (grams per week)	Non-diet				Diet				Diet and non-diet Total soft drinks	No of subjects (unweighted) Mean (g)
	Ready to drink	Concen- trated*	Carbo- nated	Total non diet drinks	Ready to drink	Concen- trated*	Carbo- nated	Total diet drinks		
	Mean (g)	Mean (g)	Mean (g)	Mean (g)	Mean (g)	Mean (g)	Mean (g)	Mean (g)	Mean (g)	Mean (g)
Males and females										
1½ - 4½ years	213	1291	419	1924	22	698	111	831	2755	1675
Males aged (years):										
4-6	227	703	491	1421	80	1105	341	1526	2946	184
7-10	218	859	807	1884	26	924	447	1396	3280	256
11-14	162	660	1266	2088	37	776	599	1412	3500	237
15-18	83	758	1889	2731	23	493	419	935	3667	179
19-64	69	282	725	1075	5	217	376	598	1673	766
65+ (free-living)	18	127	130	275	-	33	39	72	347	632
65+ (living in an institution)	68	579	58	705	11	122	11	144	848	204
Females aged (years)										
4-6	215	640	563	1418	62	953	332	1347	2764	171
7-10	211	758	671	1640	53	810	523	1386	3026	226
11-14	167	449	1036	1651	10	641	471	1122	2773	238
15-18	115	489	1129	1733	22	365	458	844	2577	208
19-64	88	198	420	707	8	157	540	705	1412	958
65+ (free-living)	17	126	111	254	2	32	34	68	322	643
65+ (living in an institution)	37	565	95	696	8	155	1	163	859	208

* Includes water used as a diluent

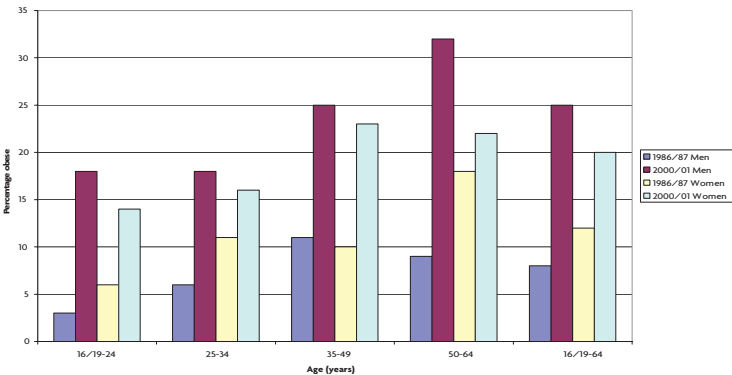
Energy and macronutrient intakes and blood lipids

Adults 19-64 years

Energy intake and body weight (Tables 12 & 13; Figure 4)

122. Mean energy intakes for adults in 2000/01 fell below Estimated Average Requirements (EARs) for men and women in all age groups, and were 80-90% of EAR. However, the increasing prevalence of obesity suggests that energy intakes are generally in excess of requirements rather than inadequate. Data from the two surveys of adults in 1986/87 and 2000/01 showed that the prevalence of obesity or overweight (BMI above 25) had increased from 45% of men and 36% of women who were obese or overweight in 1986/87 to 66% of men and 53% of women in 2000/01. This trend is confirmed by data from the Health Survey for England. Mean energy intakes in the 1986/87 survey were also below EARs. Comparing the 1986/87 and 2000/01 surveys, mean energy intake had fallen slightly in men but was unchanged in women. Interpretation of findings on energy and nutrient intakes should bear in mind the prevalence and degree of under-reporting in the datasets (see para 97).

Figure 4: Comparison of prevalence of obesity (BMI greater than 30kg/m²) in adults in 1986/87 and 2000/01.



Note: Age range for 1986/87 survey 16-64 years, 2000/01 survey 19-64 years.

123. There is evidence of low energy intakes in some younger women and to a lesser extent young men. In the 19-24 age group 10% of women had energy intakes below 4MJ/day (EAR is 8.1MJ/day for this group). Six percent of men in the same age group had energy intakes below 6MJ/day (EAR 10.6MJ/day).

Fat and fatty acids (Table 13; Figure 5)

124. The percentage of food energy from fat in 2000/01 was 35.8% for men and 34.9% for women, close to the DRV of 35% and lower than in 1986/87 (40% for both men and women).
125. The percentage of food energy from saturated fatty acids in 2000/01 was also lower than in 1986/87 - 13% of food energy for men and women in 2000/01 compared with 17% in 1986/87, although intake in 2000/01 was still above the DRV (11% of food energy). Trans fatty acid intake followed a similar pattern and in 2000/01 met the DRV of 2% of food energy.
126. The main source of dietary fat for adults was meat and meat products, followed by cereals & cereal products. The main sources of saturated fat were milk & milk products and meat & meat products, followed by cereals & cereal products.
127. Secondary analysis of the adults 2000/01 dataset²⁹ to examine the dietary characteristics of high consumers of fat and saturated fat showed differences between high and low consumers of fat and saturated fat in the contribution of food groups to intakes. For example, very high fat consumers (>39% food energy from fat) derived a higher proportion of their fat intake from cream, cheese, sausages, meat pies, chips, and crisps and savoury snacks, compared with low fat consumers (35% food energy from fat or less).

Blood lipids (Tables 18a-c & 19)

128. In adults, circulating levels of plasma total cholesterol and its subfractions are predictors of coronary heart disease. Cholesterol bound to low density lipoproteins (LDL cholesterol) is the major proportion of total cholesterol. In adults the risk of CHD is positively correlated with concentrations of both total cholesterol and LDL cholesterol. Cholesterol bound to high density lipoproteins (HDL cholesterol) is a smaller proportion of the total and may be inversely related to CHD development.
129. The blood lipid data from the 1986/87 and 2000/01 adults surveys presented in Tables 18a-c show evidence of substantial changes in blood lipid levels in this age group, especially in older men. Table 18a shows that mean plasma total cholesterol levels were lower in all age/sex groups in 2000/01 compared with 1986/87 and the proportion with levels below 5.2mmol/l, the cut-off point related to reduced risk of cardiovascular disease, was higher in 2000/01 than in 1986/87. For example, for men mean total plasma cholesterol levels

in 2000/01 were 13% lower in the 50-64 age group and 6% lower in the 19-24 age group compared with 1986/87, and for women levels were 11% and 9% lower in the 50-64 and 19-24 age groups respectively. This is a positive change which is at least partially attributable to reductions in the saturated fatty acid content of the diet and has resulted in a significant reduction in cardiovascular disease risk, particularly in older men. Generally accepted estimates at the population level predict that a decrease of 1% in total cholesterol will reduce cardiovascular disease risk by 1-2%.³⁰ On this basis these data suggest reduction in risk of around 20% for the 50-64 age group and around 10% in the 19-24 age group for both men and women. It is unclear whether the differences are entirely attributable to changes in the fat content of the diet over this period as there has also been an increase in the use of Statins to lower blood lipid levels. However these blood lipid data pre-date the widespread use of Statins so they are unlikely to be the explanation for the reduction in plasma total cholesterol, particularly given the marked fall in saturated fat intake over the same period. The 1986/87 and 2000/01 surveys used different assays for plasma cholesterol and this should be borne in mind when interpreting the results. However the differences in blood lipid levels between men and women and old and young are as expected, which adds weight to the assertion that the differences between the two sets of data represent a genuine decline in blood lipid levels. Data from the Health Survey for England also shows a drop in mean plasma total cholesterol levels between 1994 and 1998 but there was no significant change between 1998 and 2003.

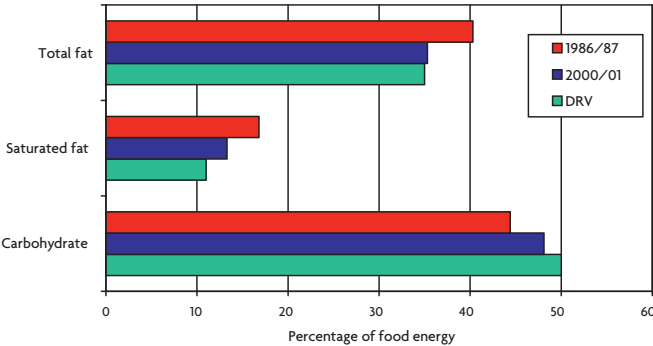
130. Table 18c shows that mean plasma LDL cholesterol levels were also lower in 2000/01 compared with 1986/87 in adult men and women. This is in line with the fall in plasma total cholesterol discussed above. For example for men mean LDL cholesterol levels in 2000/01 compared with 1986/87 were 16% lower in the 50-64 age group and 4% lower in the 19-24 age group, while for women levels were 13% and 9% lower in the 50-64 and 19-24 groups respectively. A 1% decrease in LDL is estimated to provide a 2% decreased risk of coronary heart disease³¹ so the data from these surveys suggest a reduction in risk of around a third in the 50-64 group and 8% in the 19-24 group. However Table 18(b) also suggests that mean HDL cholesterol levels in younger men and women are slightly lower in 2000/01 compared with 1986/87. A reduction in HDL cholesterol is associated with insulin resistance and obesity. In the 2000/01 survey mean HDL levels in younger men and women tended to be lower than in the oldest group. Conversely, data from the Health Survey for England shows that mean HDL cholesterol for men was marginally higher in 2003 compared with 1998.

131. The ratio of total: HDL cholesterol is considered a predictor of the effects of dietary fatty acids on cardiovascular disease risk. A ratio above 5 is associated with increased risk³². Comparing the ratios in the 1986/87 and 2000/01 surveys, for men the ratio was lower in 2000/01 compared with 1986/87 for age groups 25-34, 35-49 and 50-64, indicating a proportional increase in HDL relative to total cholesterol, while in the youngest (19-24) group the ratio was slightly higher in 2000/01, indicating a proportional reduction in HDL. For women there are no clear age differences with the ratio in 2000/01 lower in the youngest and oldest group and higher in the middle two groups. A decrease in the ratio of one unit has been estimated to reduce risk of CVD by 50%³³ so for the 50-64 year old men this equates to a 46.5% reduction in risk, a major impact. However in younger men the ratio has increased, meaning that the proportional decrease in HDL cholesterol is greater than the proportional decrease in LDL cholesterol.

Carbohydrate and non-milk extrinsic sugars (Tables 13 & 14; Figure 5)

132. The most recent data on adults 19-64 years (2000/01) showed mean intakes of total carbohydrate at 47.7% of food energy for men and 48.5% for women, close to the DRV of 50% and higher than in 1986/87.
133. Mean intake of non-milk extrinsic sugars (NMES) exceeded the DRV of 11% of food energy, at 13.6% for men and 11.9% for women. Intakes were highest in the 19-24 age group in which the mean percentage of food energy derived from NMES was 17.4% for men and 14.2% for women. Intakes at the upper 2.5%ile were almost 30% of food energy.
134. The main single source of NMES for the 19-64 age group overall was table sugar, followed by soft drinks and biscuits, buns, cakes and pastries. In the 19-24 age group soft drinks was the major source and provided over a third of mean intake.
135. Secondary analysis of NDNS adults 2000/01 data to examine the characteristics of high consumers of NMES²⁹ (>15% food energy from NMES) showed that compared with low NMES consumers (11% or less food energy from NMES), this group derived a higher proportion of their NMES intake from table sugar, confectionery, soft drinks and alcopops. Men in this group also derived a higher proportion of their intake from puddings and beer and lager and women from breakfast cereals, biscuits, buns, cakes and pastries and fruit juice.

Figure 5: Comparison of food energy intakes from total fat, saturated fat and total carbohydrate between 1986/87 and 2000/01 adult surveys.



Non-starch polysaccharides (NSP) (Table 15)

136. Mean NSP intakes in 2000/01 were 15.2g/day for men and 12.6g/day for women, well below the DRV of 18g/day. A third of men and half of women had intakes below 12g per day, the COMA individual minimum. Cereals & cereal products was the main source, providing over 40% of intake. Vegetables and vegetable dishes provided a fifth of intake. It is not possible to compare intakes with the 1986/87 survey of adults as that survey used the Southgate analytical method for dietary fibre.

Alcohol (Tables 16 & 17)

137. In the 2000/01 survey, 60% of men and 44% of women exceeded the recommended daily benchmarks for sensible drinkingⁱ on at least one of the seven reporting days. Eighteen percent of men and 7% of women exceeded the benchmarks on four or more days of the week, with 3% of men exceeding the benchmark on all seven days. Thirty-nine percent of men and 22% of women drank more than twice the benchmarks on their heaviest drinking day.
138. Alcohol provided 6.5% of total energy intake on average for men and 3.9% for women in the 19-64 age group. There were no significant age differences in the contribution of alcohol to energy intake.

ⁱ Current advice for adults is that men should drink no more than three to four units of alcohol a day and women no more than two to three units a day. Consistently drinking four or more units a day for men or three or more units a day for women is not advised as a sensible drinking level because of the progressive health risk it carries. One unit is approximately equivalent to half a pint of beer, lager or cider, a single measure of spirits, one small glass of wine or a small glass of sherry, port or other fortified wine. One unit is equivalent to 8 grams alcohol.

Older adults 65 years and over

Energy intake (Table 12)

139. Mean energy intakes were below EARs. In the free-living group mean energy intake was 85% of EAR in men and 76% in women and for men was lowest in the 85+ age group.
140. In the institution group mean energy intake was about 90% of the EAR.

Fat and fatty acids (Table 14)

141. In the free-living group, mean fat intakes were just above the DRV at 35.7% of food energy for men and 36.1% for women. Saturated fat intakes were well above the DRV at 15% of food energy intake. Trans fatty acid intakes met the DRV. The main sources of total fat were cereals & cereal products, meat and meat products and fat spreads, each contributing about a fifth of intake. Milk and milk products was the main source of saturated fat, followed by cereals & cereal products and meat & meat products.
142. In the institution group mean fat intake in men was close to the DRV and in women met the DRV. Saturated fat intakes were well above the DRV at 15% of food energy intake. Trans fatty acid intakes met the DRV. Meat and meat products made less contribution to fat intake than in the free-living group. The main sources of total fat were cereals & cereal products, milk & milk products and fat spreads, and of saturated fat were milk & milk products, cereals & cereal products and fat spreads.

Blood lipids (Table 18a-c)

143. Overall 34% of men and 24% of women in the free-living group and 62% of men and 43% of women in the institution group had a plasma total cholesterol concentration below 5.2mmol/l. Severely elevated levels (>7.8mmol/l) were found in 3% of men and 14% of women in the free-living group and about 1% of men and women in the institution group. In the free-living group mean total cholesterol levels decreased with age in men but not women. Mean LDL cholesterol concentrations also decreased with age for men in both groups.

Carbohydrate and non-milk extrinsic sugars (NMES) (Table 14)

144. Total carbohydrate intake in the free-living group was 48% of food energy intake, close to the DRV and similar to the 19-64 group. NMES intake in men exceeded the DRV at 13% of food energy and in women was just above the DRV.

145. In the institution group total carbohydrate intake was higher than in the free-living group and met the DRV, at 51% of food energy intake for both men and women. This was largely due to the higher intake of NMES in this group, 17.9% and 18.5% of food energy in men and women respectively. Sugars, preserves and confectionery contributed about half the total intake; table sugar was the largest single contributor. Buns, cakes, pastries and puddings provided another fifth of intake and 9% came from drinks.
146. Sugar, preserves and confectionery was the main source of NMES intake in both the free-living and institution groups, providing over 40% of intake in the free-living group and about half in the institution group. Table sugar was the largest single contributor. Cereals & cereal products provided around 30% of intake.

Non-starch polysaccharides (NSP) (Table 15)

147. Mean NSP intakes were below the DRV of 18 grams/day in both groups. Intake in the institution group was lower than in the free-living group.

Alcohol (Table 16)

148. In the free-living group the percentage of total energy intake derived from alcohol was 4% for men and 1% for women. Reported alcohol consumption and the percentage of total energy derived from alcohol was lower in the institution group than in the free-living group.

Children and young people 1½-18 years

Energy intake (Table 12)

149. Mean energy intakes were below the EARs in all groups. In girls aged 15-18 years mean energy intake was 77% of the EAR and in other groups 80-90% of EAR.

Fat and fatty acids (Table 14)

150. The mean percentage of food energy from total fat was above the DRV in all age groups, at about 36% on average. Mean intake of saturated fat was 17% of food energy in the 1½-2½ year group and declined with age to 15% of food energy in the 4-6 year group and 14% in the oldest group. Trans fatty acid intakes met the DRV in all age groups. Milk and milk products was the main source of total fat and saturated fat in the 1½-4½ group, providing over a quarter of total fat and over a third of saturated fat. In older children cereals & cereal products, meat & meat products and potatoes & savoury snacks replaced milk as the

main source of fat. The main sources of saturated fat in older children were milk & milk products, cereals & cereal products and meat & meat products.

Carbohydrate and non-milk extrinsic sugars (Table 14)

151. Mean intakes of total carbohydrate met the DRV for all age groups.
152. Mean NMES intakes exceeded the DRV in all age groups. The 1½-4½ year age group had the highest mean intakes at 18.8% of food energy for boys and 18.6% for girls. In older children mean intakes were at 16-17% of food energy and there was a wide range of intakes, from 5-8% of food energy at the lower 2.5 percentile to 26-31% at the upper 2.5 percentile. In the youngest children intakes at the upper 2.5 percentile were 35-37% of energy. Soft drinks (mainly carbonated) was the single largest contributor to NMES intake in all age groups, providing a quarter to a third of intake on average. Sugar, preserves and confectionery contributed around 30% of intake and cereals & cereal products (including biscuits, buns, cakes and pastries) 25%. The contribution of soft drinks increased with age, carbonated soft drinks alone provided 28% of NMES intake for boys aged 15-18. The contribution of cereals & cereal products tended to fall with age.

Non-starch polysaccharides (NSP) (Table 15)

153. Mean NSP intakes in all age groups were below the DRV of 18g/day for adults. Intakes increased with age from 6g/day in the 1½-4½ age group to 13g in boys and 11g in girls in the 15-18 age group.

Alcohol (Table 16)

154. In the 15-18 age group 1.9% of energy intake for boys and 1.4% for girls was derived from alcohol. Alcohol consumption reported in the dietary interview was 9 unitsⁱⁱ per week for boys and 7 units per week for girls. Consumption in the 11-14 group was reported at 0.5 units per week.

Overview of energy and macronutrient intakes

155. Mean energy intakes fell below EARs in all age/sex groups. The difference between reported energy intakes and EARs is likely to arise from a combination of factors including mis-reporting and the possible overestimation of energy requirements due to a decrease in physical activity levels.

ⁱⁱ One unit is approximately equivalent to half a pint of beer, lager or cider, a single measure of spirits, one small glass of wine (125 mls) or a small glass of sherry, port or other fortified wine. One unit is equivalent to 8 grams alcohol.

156. Fat intakes were generally just above the DRV and met the DRV for women aged 19-64 and women aged 65 and over living in an institution. Saturated fat intakes exceeded the DRV in all groups. Milk & milk products, cereals & cereal products and meat & meat products were the major sources of fat and saturated fat, the contribution of milk decreasing with age, and that of meat increasing.
157. The percentage of food energy derived from carbohydrate met or was close to meeting the DRV of 50% in all age groups. Intakes in children and older people in institutions are above the DRV although this is largely due to the high consumption of NMES in these age groups. NMES intake exceeded the DRV in all age groups and was highest in children and older people in institutions. Soft drinks were the major source of NMES in children and young adults and table sugar in older adults.
158. All groups had mean protein intakes above the Reference Nutrient Intake levels. Protein intake as a percentage of the RNI declined with age from 244% in 1½-4½ year old children to 120% in free-living older women.
159. Intake of non-starch polysaccharides was low overall and no groups met the DRV for adults.
160. Alcohol made a significant contribution to energy intake in some consumers and a substantial proportion of adults exceeded the sensible drinking recommendations.

Table 12: Average daily total energy intake (MJ) as a percentage of the estimated average requirement (EAR)** by sex and age of respondent

Gender and age of respondent	Mean energy intake (MJ)	Intake as % EAR**	Number of subjects [†]
Males and females aged 1½-2½ years***	4.39	90%	538
Males and females aged 2½-3½ years***	4.88	84%	578
Males aged (years)			
3½-4½***	5.36	82%	250
4 – 6	6.39	89%	184
7 – 10	7.47	91%	256
11- 14	8.28	89%	237
15 – 18	9.60	83%	179
19 – 24	9.44	89%	61
25 – 34	9.82	93%	160
35 – 49	9.93	94%	303
50 – 64	9.55	92%	242
65+ <i>Free-living</i>	8.02	85%	632
65+ <i>Living in an institution</i>	8.14	91%	204
Females aged (years)			
3.5-4.5***	4.98	82%	243
4 – 6	5.87	91%	171
7 – 10	6.72	92%	226
11- 14	7.03	89%	238
15 –18	6.82	77%	210
19 – 24	7.00	86%	78
25 – 34	6.61	82%	211
35 – 49	6.96	86%	379
50 – 64	6.91	87%	290
65+ <i>Free-living</i>	5.98	76%	643
65+ <i>Living in an institution</i>	6.94	90%	208

** Standard EAR values used for each age/sex group as published in the UK Dietary Reference Values.¹¹ EAR values for each age/sex group were derived from BMR calculated from the modified Schofield equations using mean body weight values for each age/sex group. PAL for adults taken as 1.4. The Estimated Average Requirements (EARs) for energy used are:

Men:	Women:
4-6 years: 7.16 MJ/day	6.46 MJ/day
7-10 years: 8.24 MJ/day	7.28 MJ/day
11-14 years 9.27 MJ/day	7.92 MJ/day
15-18 years 11.51 MJ/day	8.83 MJ/day
19 to 50 years: 10.60MJ/d	19 to 50 years: 8.10MJ/d
51 to 59 years: 10.60MJ/d	51 to 59 years: 8.00MJ/d
60 to 64 years: 9.93MJ/d	60 to 64 years: 7.99MJ/d

Energy intake as a percentage of EAR was calculated for each respondent using the EAR appropriate for sex and age.

*** Energy intakes per kilogram body weight were compared with EAR per kg body weight to calculate Intake as % of EAR.

Table 13: Macronutrient intakes for adults in 1986/87 and 2000/01

Macronutrient	1986/87 Adults survey 16-64 years	2000/01 NDNS Adults 19-64 years	Dietary Reference Value* (population average)
Men			
Mean daily total energy intake (kcal)	2450	2313	2550 (19-59yrs) 2380 (60-64yrs)
% food energy from total carbohydrate	44.7	47.7	50%
% food energy from non-milk extrinsic sugars	n/a	13.6	No more than 11%
% food energy from protein	15.2	16.5	n/a
Mean protein intake as % RNI	154	161	RNI 55.5g/day (19- 50 yrs) 53.3g/day (50+ yrs)
% food energy from total fat	40.4	35.8	No more than 35%
% food energy from saturated fatty acids	16.5	13.4	No more than 11%
% food energy from trans unsaturated fatty acids	2.2	1.2	No more than 2%
% food energy from cis monounsaturated fatty acids	12.4	12.1	Population average 13%
% food energy from cis n-3 polyunsaturated fatty acids	0.8	1	
% food energy from cis n-6 polyunsaturated fatty acids	5.4	5.4	
Women			
Mean daily total energy intake (kcal)	1680	1632	1940 (19-50yrs)
% food energy from total carbohydrate	44.2	48.5	50%
% food energy from non-milk extrinsic sugars	n/a	11.9	No more than 11%
% food energy from protein	15.6	16.6	n/a
Mean protein intake as % RNI	137	140	RNI 45.0g/day (19- 50 yrs) 46.5g/day (50+ yrs)
% food energy from total fat	40.3	34.9	No more than 35%
% food energy from saturated fatty acids	17	13.2	No more than 11%
% food energy from trans unsaturated fatty acids	2.2	1.2	No more than 2%
% food energy from cis monounsaturated fatty acids	12.2	11.5	13%
% food energy from cis n-3 polyunsaturated fatty acids	0.8	1	
% food energy from cis n-6 polyunsaturated fatty acids	5.3	5.3	

Table 14: Percentage of food energy from total carbohydrate, non-milk extrinsic sugars (NMES), protein, total fat, saturated fatty acids and trans fatty acids and comparison with COMA Dietary Reference Values (DRVs)

Gender and age	Percentage food energy from:					No of subjects (unweighted)	
	Total carbohydrate	NMES	Protein	Total fat	Saturated fatty acids		Trans fatty acids
Males aged (years)							
1.5-4.5	51.4	18.8	12.8	35.7	16.2	1.7	848
4 – 6	51.6	16.2	12.9	35.5	14.8	1.3	184
7 – 10	52.4	17.5	12.4	35.2	14.3	1.4	256
11 – 14	51.7	16.9	13.1	35.2	13.8	1.3	237
15 – 18	50.5	15.8	13.9	35.9	13.9	1.4	179
19 – 24	49.0	17.4	14.9	36.0	13.5	1.2	61
25 – 34	47.7	13.9	16.5	35.8	13.2	1.2	160
35 – 49	47.5	13.1	16.7	35.9	13.5	1.2	303
50 – 64	47.4	12.2	17.0	35.6	13.4	1.2	242
65+ Free -living	48.2	13.2	16.1	35.7	14.6	1.5	632
65+ Living in an institution	50.8	17.9	14.1	35.1	15.2	1.7	204

Dietary reference values (DRVs) are:

Total carbohydrate should make up more than 50% of food energy intake

NMES should make up less than 11% of food energy intake

Total fat should make up less than 35% of food energy intake

Saturated fats should make up less than 11% of food energy intake

Trans fatty acids should make up less than 2% of food energy intake

Table 14 (continued). Percentage of food energy from total carbohydrate, non-milk extrinsic sugars (NMES), protein, total fat, saturated fatty acids and trans fatty acids and comparison with COMA Dietary Reference Values (DRVs)

Gender and age	Percentage food energy from:					No of subjects (unweighted)	
	Total carbohydrate	NMES	Protein	Total fat	Saturated fatty acids		Trans fatty acids
Females aged (years)							
1.5-4.5	50.8	18.6	13.1	36.1	16.2	1.7	827
4 – 6	51.4	17.6	12.7	35.9	15.3	1.3	171
7 – 10	51.3	16.7	12.8	35.9	14.5	1.4	226
11 – 14	51.2	16.2	12.7	36.1	14.0	1.3	238
15 –18	50.6	15.3	13.9	35.9	13.8	1.3	210
19 – 24	49.1	14.2	15.4	35.5	12.9	1.1	78
25 – 34	48.7	11.8	15.9	35.4	13.2	1.1	211
35 – 49	48.6	11.8	16.7	34.7	13.2	1.2	379
50 – 64	48.1	11.0	17.4	34.5	13.3	1.2	290
65+ Free -living	47.5	11.5	16.5	36.1	15.3	1.6	643
65+ Living in an institution	51.3	18.5	14.0	34.8	15.4	1.8	208

Dietary reference values (DRVs) are:

Total carbohydrate should make up more than 50% of food energy intake

NMES should make up less than 11% of food energy intake

Total fat should make up less than 35% of food energy intake

Saturated fats should make up less than 11% of food energy intake

Trans fatty acids should make up less than 2% of food energy intake

Table 15: Mean non-starch polysaccharides intake (grams per day)

Gender and age	Mean intake (g)	Number of subjects (unweighted)
Males aged (years)		
1.5-4.5	6.3	848
4 – 6	9.1	184
7 – 10	10.3	256
11- 14	11.6	237
15 – 18	13.3	179
19 – 24	12.3	61
25 – 34	14.6	160
35 – 49	15.7	303
50 – 64	16.4	242
65+ <i>Free-living</i>	13.5	632
65+ <i>Living in an institution</i>	11.0	204
Females aged (years)		
1.5-4.5	5.9	827
4 – 6	8.0	171
7 – 10	9.8	226
11 – 14	10.2	238
15 – 18	10.6	210
19 – 24	10.6	78
25 – 34	11.6	211
35 – 49	12.8	379
50 – 64	14.0	290
65+ <i>Free-living</i>	11.0	643
65+ <i>Living in an institution</i>	9.5	208

Table 16: Alcohol consumption

Gender and age	% total energy from alcohol*	Mean weekly alcohol consumption (units)**	Number of subjects (unweighted) [†]
Males aged (years)			
11 – 14	0.0	0.5	237
15 – 18	1.9	9.1	179
19 – 24	6.0	27.8	61
25 – 34	6.6	21.6	160
35 – 49	6.8	20.7	303
50 – 64	6.4	18.3	242
65+ <i>Free-living</i>	4.0	N/a	632
65+ <i>Living in an institution</i>	0.9	N/a	204
Females aged (years)			
11 – 14	0.1	0.5	238
15 – 18	1.4	6.7	210
19 – 24	4.6	16.2	78
25 – 34	4.0	10.0	211
35 – 49	3.9	8.0	379
50 – 64	3.7	6.5	290
65+ <i>Free-living</i>	1.3	N/a	643
65+ <i>Living in an institution</i>	0.2	N/a	208

* Data from 7- day dietary record includes alcohol consumed as part of recipe dishes.

** Data from interview.

[†] Number of subjects based on 7-day dietary record

N/a – data not available

Table 17: Number of days on which units of alcohol consumed exceeded the recommended daily benchmarks

Number of days on which units of alcohol consumed exceeded the recommended daily benchmarks	Aged 19-64	
	Men	Women
	%	%
0	40	56
1	18	18
2	14	11
3	10	7
4	6	4
5	6	2
6	3	1
7	3	0
<i>Number of subjects (unweighted)</i>	766	958

Table 18(a): Percentage distribution of plasma total cholesterol by sex and age of respondent

Total cholesterol (mmol/l)	Males aged (years)															
	1986/87 Adults Survey					2000/01 NDNS					Free-living participants				Institution participants	
	18-24 %	25-34 %	35-49 %	50-64 %	19-24 %	25-34 %	35-49 %	50-64 %	65-74 %	75-84 %	85 & over %	65-84 %	85 & over %			
Less than 5.20	75	41	21	13	84	59	44	41	29	39	60	55	73			
Less than 7.80	100	96	91	90	100	98	98	98	96	97	100	99	100			
Mean (average)	4.7	5.5	6.1	6.4	4.40	5.04	5.38	5.56	5.75	5.37	4.84	5.07	4.39			
Median	4.6	5.5	6.0	6.3	4.29	4.93	5.41	5.56	5.70	5.40	4.80	4.92	4.25			
Upper 2.5%ile	*6.4	*7.4	*8.1	*8.3	6.33	7.80	7.47	7.76	8.10	7.75	7.25	7.34	6.32			
Lower 2.5%ile	*3.4	*4.0	*4.6	*4.8	3.20	2.99	3.06	3.35	3.56	2.97	2.18	2.95	2.10			
Number of subjects (unweighted)	139	216	317	251	45	115	243	189	200	191	67	82	54			
Total cholesterol (mmol/l)	Females aged (years)															
	1986/87 Adults Survey					2000/01 NDNS					Free-living participants				Institution participants	
	18-24 %	25-34 %	35-49 %	50-64 %	19-24 %	25-34 %	35-49 %	50-64 %	65-74 %	75-84 %	85 & over %	65-84 %	85 & over %			
Less than 5.20	66	61	35	10	83	68	52	25	24	23	27	42	44			
Less than 7.80	98	99	97	79	100	99	99	91	85	86	90	99	99			
Mean (average)	4.9	5.1	5.7	6.8	4.46	4.84	5.13	6.06	6.24	6.30	5.95	5.60	5.36			
Median	4.8	5.0	5.6	6.8	4.55	4.69	5.16	6.05	6.09	6.29	5.83	5.45	5.29			
Upper 2.5%ile	*6.7	*6.3	*7.4	*9.0	6.04	6.92	7.17	8.69	9.27	9.85	8.25	7.52	7.52			
Lower 2.5%ile	*3.6	*3.9	*4.1	*4.9	2.83	3.01	3.44	4.16	3.74	3.06	3.07	2.90	2.90			
Number of subjects (unweighted)	84	170	315	240	47	154	296	206	178	150	100	55	57			

* Values for 1986/87 are 5.0 percentile

Table 18(b) : Percentage distribution of plasma high-density lipoprotein (HDL) cholesterol by sex and age of respondent

HDL cholesterol	Males aged (years)												
	1986/87 Adults Survey						2000/01 NDNS						Institution participants
	18-24 %	25-34 %	35-49 %	50-64 %	19-24 %	25-34 %	35-49 %	50-64 %	65-74 %	75-84 %	85 & over %	65-84 %	
Less than 1.00	27	36	31	39	43	44	46	42	41	38	41	56	59
Less than 1.20	63	58	64	65	77	77	77	69	58	59	56	78	68
Less than 1.40	85	76	81	81	92	91	89	84	78	78	73	84	94
Less than 1.60	94	89	90	91	100	98	95	92	85	85	88	94	98
Mean (average)	1.1	1.2	1.2	1.1	1.06	1.04	1.04	1.12	1.17	1.19	1.14	0.99	0.97
Median	1.1	1.1	1.1	1.1	1.07	1.02	1.01	1.04	1.09	1.10	1.06	0.94	0.87
Upper 2.5%ile	1.62	1.76	1.84	1.76	1.49	1.58	1.87	1.85	2.32	2.28	1.95	1.80	1.49
Lower 2.5%ile	*0.74	*0.73	*0.73	*0.63	0.68	0.61	0.56	0.64	0.52	0.58	0.58	0.46	0.45
Number of subjects (unweighted)	139	214	315	251	45	115	243	189	200	191	67	82	53

* Values for 1986/87 are 5.0 percentile

Table 18(b) (continued): Percentage distribution of plasma high-density lipoprotein (HDL) cholesterol by sex and age of respondent

HDL cholesterol (mmol/l)	Females aged (years)												
	1986/87 Adults Survey					2000/01 NDNS					Free-living participants		
	18-24 %	25-34 %	35-49 %	50-64 %	19-24 %	25-34 %	35-49 %	50-64 %	65-74 %	75-84 %	85 & over %	Institution participants	
Less than 1.00	15	9	12	10	24	20	22	18	18	17	21	38	36
Less than 1.20	35	29	32	29	52	42	45	38	38	33	40	53	63
Less than 1.40	66	50	52	50	76	68	71	64	59	52	53	66	78
Less than 1.60	84	72	71	70	90	86	84	79	72	71	76	77	84
Mean (average)	1.3	1.4	1.4	1.4	1.21	1.26	1.27	1.34	1.39	1.41	1.35	1.26	1.19
Median	1.3	1.4	1.4	1.4	1.18	1.24	1.24	1.31	1.29	1.35	1.33	1.11	1.10
Upper 2.5%ile	*1.80	*2.01	*2.09	*2.19	1.71	1.97	2.34	2.36	2.58	2.36	2.22	2.69	2.05
Lower 2.5%ile	*0.88	*0.92	*0.89	*0.83	0.75	0.66	0.70	0.69	0.71	0.71	0.59	0.66	0.63
Number of subjects (unweighted)	82	170	314	240	47	154	296	206	178	150	100	56	57

* Values for 1986/87 are 5.0 percentile

Table 18(c): Percentage distribution of plasma low-density lipoprotein (LDL) cholesterol by sex and age of respondent

LDL cholesterol	Males aged (years)													
	1986/87 Adults Survey							2000/01 NDNS						
	18-24 %	25-34 %	35-49 %	50-64 %	19-24 %	25-34 %	35-49 %	50-64 %	65-74 %	75-84 %	85 & over %	Institution participants		
(mmol/l)												65-84 %	85 & over %	
Less than 3.40	45	22	8	3	60	30	23	18	13	25	41	27	49	
Less than 4.10	75	44	25	16	81	61	42	39	32	47	64	52	79	
Mean (average)	3.5	4.3	5.0	5.3	3.35	4.00	4.34	4.44	4.58	4.17	3.69	4.08	3.42	
Median	3.5	4.3	4.8	5.3	3.18	3.84	4.39	4.37	4.52	4.16	3.60	3.84	3.28	
Upper 2.5%ile	*5.2	*6.4	*7.2	*7.3	5.37	6.77	6.78	6.64	7.06	6.71	6.40	6.35	5.25	
Lower 2.5%ile	*2.2	*2.7	*3.2	*3.5	1.84	1.86	2.00	2.25	2.26	1.82	1.32	2.03	0.94	
Number of subjects (unweighted)	139	214	315	251	45	115	243	189	200	191	67	82	53	
LDL cholesterol	Females aged (years)													
	1986/87 Adults Survey							2000/01 NDNS						
	18-24 %	25-34 %	35-49 %	50-64 %	19-24 %	25-34 %	35-49 %	50-64 %	65-74 %	75-84 %	85 & over %	Institution participants		
(mmol/l)												65-84 %	85 & over %	
Less than 3.40	47	40	19	5	57	49	35	13	19	14	18	13	33	
Less than 4.10	79	75	46	16	86	77	63	31	30	32	33	46	50	
Mean (average)	3.6	3.7	4.3	5.4	3.26	3.57	3.85	4.72	4.85	4.89	4.59	4.34	4.17	
Median	3.5	3.5	4.2	5.3	3.24	3.43	3.79	4.59	4.84	4.59	4.63	4.36	4.06	
Upper 2.5%ile	*5.4	*5.1	*6.1	*7.7	4.98	5.84	6.00	7.22	7.73	8.58	6.75	6.23	6.53	
Lower 2.5%ile	*2.3	*2.6	*2.8	*3.4	1.86	1.94	2.20	2.71	2.30	1.65	1.73	1.88	1.91	
Number of subjects (unweighted)	82	170	314	240	47	154	296	206	178	150	100	55	57	

* Values for 1986/87 are 5.0 percentile

Table 19: Percentage distribution of plasma total cholesterol to HDL cholesterol ratio by sex and age of respondent

Total cholesterol to HDL cholesterol ratio	Males aged (years)									
	1986/'87 Adults Survey					2000/'01 NDNS				
	19-24	25-34	35-49	50-64	All	19-24	25-34	35-49	50-64	All
<i>Less than 5.0</i>	75	57	41	31	47	74	56	46	44	49
<i>Mean (average)</i>	4.34	5.17	5.65	6.31	5.55	4.40	4.99	5.51	5.38	5.28
<i>Median</i>	4.10	4.59	5.35	6.05	5.17	4.04	4.65	5.26	5.24	5.03
<i>Lower 2.5%ile</i>	2.40	2.82	2.79	3.12	2.73	2.40	2.20	2.51	2.37	2.48
<i>Upper 2.5%ile</i>	7.61	9.81	10.07	12.16	10.29	8.20	8.49	10.36	9.11	9.32
<i>Number of subjects (unweighted)</i>	112	199	297	240	848	46	114	237	183	580
Females aged (years)										
Total cholesterol to HDL cholesterol ratio	1986/'87 Adults Survey					2000/'01 NDNS				
	19-24	25-34	35-49	50-64	All	19-24	25-34	35-49	50-64	All
<i>Less than 5.0</i>	82	85	78	55	74	89	80	74	58	72
<i>Mean (average)</i>	4.09	3.84	4.31	5.12	4.39	3.85	4.09	4.34	4.88	4.41
<i>Median</i>	3.96	3.58	3.99	4.85	4.03	3.68	3.75	4.01	4.57	4.07
<i>Lower 2.5%ile</i>	2.57	2.46	2.51	2.68	2.53	2.34	2.32	2.25	2.52	2.33
<i>Upper 2.5%ile</i>	7.22	6.65	7.85	9.54	7.95	6.57	8.23	8.24	8.92	8.41
<i>Number of subjects (unweighted)</i>	90	217	324	240	871	47	152	293	200	692

Micronutrient intakes and status

161. The surveys collected data on intakes of vitamins and minerals estimated from food consumption records over a seven-day period and on status measures for some vitamins and minerals from analysis of blood samples taken, usually within two weeks of the dietary recording period. Status measures are available for most vitamins for which intakes were assessed, but not minerals, with the exception of iron.
162. Associations between intake measures and nutritional status measures are generally weak for most micronutrients. There are a number of reasons for this. Many measures of nutritional status indicate long-term body stores and do not reflect short-term intakes, e.g. retinol.³⁴ In other cases there are physiological reasons why intake is not directly related to status, e.g. iron status is affected by controls on intestinal absorption, variation in bioavailability and in women, menstrual blood loss³⁵. Under-reporting of food consumption may also partly explain the lack of associations between intake and status where they would otherwise be expected.
163. The analytical methods used for individual nutritional status measures are generally comparable between the NDNS surveys. Where there is doubt about comparability this has been highlighted. Thresholds used to define adequate nutritional status were those current at the time of the survey.
164. It is not possible to make comparisons of nutritional status between the 2000/01 and the 1986/87 surveys of adults because of differences in the analytical methods used.
165. The threshold for low vitamin D status (plasma hydroxy vitamin D level below 25nmol/l) has been questioned recently and there is currently no consensus.¹⁶ SACN have recently published a position statement on vitamin D¹⁶.

Adults 19-64 years

Vitamins (Tables 20,23 & 24)

166. Mean intakes of all vitamins were above the Reference Nutrient Intakes (RNI) for men and women overall (taking all ages together).
167. There was some evidence of low intakes of vitamin A and riboflavin in younger age groups (Table 20). Mean intakes of vitamin A fell below the RNI for men

and women aged 19-24. Intakes below the Lower Reference Nutrient Intake (LRNI) were found in 16% of men and 19% of women in the 19-24 age group and 7% of men and 11% of women in the 25-34 group. The main sources of vitamin A were meat and meat products and vegetables. Plasma retinol levels, which indicate long term status and do not reflect recent vitamin A intake, were above threshold levels³⁴ except for 1% of men aged 50-64 years who had marginal status.

168. Mean riboflavin intakes were above the RNI in all age/sex groups but intakes below the LRNI were found in 8% and 15% of 19-24 year old men and women respectively and in 10% of women aged 25-34. The main sources of riboflavin were milk and milk products and cereals & cereal products (mainly from fortified breakfast cereals). A high proportion of adults had marginal status levels for riboflavin based on the EGRAC index^{34,i}.
169. Mean intakes of folate were above the RNI in all age/sex groups and no more than 3% of any age group had intakes below the LRNI. However only 14% of women aged 19-24 years, 8% of the 25-34 year group and 16% of the 35-49 group had a folate intake of 400µg/day or more, including intake from supplementsⁱ. The main dietary source of folate was cereals & cereal products, which provided a third of intake. Five percent of men and women had a red cell folate concentration indicative of marginal status with increased risk of deficiency³⁷. This increased to 8% of the 19-24 year old women and 13% of the 19-24 year old men. No more than 1% of any age/sex group had a red cell folate concentration indicating severe deficiency (Tables 20 & 23)
170. Five percent of men and 3% of women had plasma vitamin C levels below 11µmol/l indicating biochemical depletion³⁸. The proportion with vitamin intakes below the LRNI was below 0.5%.
171. Low vitamin D status (plasma hydroxy vitamin D level below 25nmol/l)³⁷ was found in around 15% of the adult population overall and a quarter of the 19-24 age group (24% of men and 28% of women). The proportion with low status

ⁱ Erythrocyte Glutathione Reductase Activation Co-efficient (EGRAC) is a measure of red cell enzyme saturation with its riboflavin-derived -co-factor, flavin adenine dinucleotide. There are issues with the activation coefficient used to define those subjects who have marginal riboflavin status. An activation coefficient of >1.2 was originally proposed to define marginal riboflavin status (Glatzle *et al.*, 1970). Subsequent revisions to the methodology (Thurnham *et al.*, 1972; Thurnham & Rathakette, 1982) resulted in a systematic increase in activation coefficients and the adoption of an activation coefficient of >1.3 to define marginal riboflavin status. Further increases in activation coefficients may have occurred as a consequence of methodological changes to the EGRAC assay and the activation coefficient used to define marginal riboflavin status should be re-evaluated.

ⁱⁱ The Department of Health currently recommend that those women who could become pregnant take a supplement of 400µg folic acid per day prior to conception and until the twelfth week of pregnancy in order to minimise the risk of neural tube defects.

was higher during the winter months. No RNI has been set for vitamin D in adults aged under 50 years.

Minerals (Tables 21 & 22)

172. Mean intakes of most minerals were above the RNIs for men and women overall (taking all age groups together). However there was evidence of low intakes of a number of minerals, including potassium, magnesium, zinc, and, for women, iron, calcium, copper and iodine, especially in the younger age groups.
173. Mean iron intakes in women were well below the RNI in all but the 50-64 age group. In the 19-24 and 25-34 groups over 40% had intakes below the LRNI. Cereals & cereal products was the main food source, providing over 40% of average intake. Under a fifth of intake came from meat & meat products on average for the group as a whole. Eight percent of women and 3% of men overall had haemoglobin levels below the WHO thresholds defining anaemia³⁹. Eleven percent of women and 4% of men had serum ferritin levels below the normal range⁴⁰, increasing to 16% of women in the 19-24 group.
174. Mean potassium intakes were below the RNI in all age groups for women and in the youngest men (19-24). Intakes below the LRNI were found in 30% of women aged 19-34 and 18% of men aged 19-24.
175. Mean intakes of magnesium were below the RNI for women in all age groups and men in the youngest group. Nine percent of men and 13% of women had intakes below the LRNI, increasing to 17% of men aged 19-24 and around a fifth of women in the 19-24 and 25-34 age groups. Cereals & cereal products was the main source, followed by drinks. Beer and lager was a significant source for men.
176. Mean intakes of zinc were close to or above the RNI in all age / sex groups. Intakes below the LRNI were found in 7% and 5% of the youngest men and women respectively. About a third of intake came from meat, a quarter from cereals & cereal products and a sixth from milk & milk products.
177. Five percent of men and 8% of women in the youngest 19-24 age group had calcium intakes below the LRNI. Milk & milk products provided over 40% of average intake, and cereals & cereal products 30%.
178. Twelve percent of women in the 19-24 age group had iodine intakes below the LRNI. Milk & milk products provided over 40% of intake for women and fish 12%

of intake. Mean copper intakes fell below the RNI for women in all age groups. For adults as a group, around a third of copper intake came from cereals & cereal products and a sixth of intake from meat & meat products.

Older adults 65 years and over

Vitamins (Tables 20,23 & 24)

179. Mean intakes of almost all vitamins were above RNIs in the free-living and institution groups. However there was evidence of intakes below the LRNI for a number of vitamins in the free-living group, including riboflavin, folate, and vitamin A, particularly in women and in the oldest group, aged 85 and over. Eleven percent of women in the free-living group aged 85 and over had folate intakes below the LRNI, 15% fell below the LRNI for riboflavin, 6% for vitamin B₆ and 4% for vitamin C, vitamin A and vitamin B₁₂.
180. There was also evidence of low status for these vitamins. Fifteen percent of the free-living group had serum folate concentrations below the normal range³⁷. Eight percent had red cell folate concentrations indicating severe deficiency while 21% had a marginal status. Low plasma vitamin C levels, indicating biochemical depletion, were found in 14% overall and about a fifth of the oldest free-living men and women. Over 40% overall had EGRAC levels indicating marginal riboflavin statusⁱⁱⁱ.
181. Vitamin D intakes were below the RNI in all groups. Overall, 6% of men and 10% of women in the free-living group had low vitamin D status based on the threshold of low status of plasma hydroxy vitamin D below 25nmol/l.^{17,41} This increased in the winter months.
182. In the institution group there was also some evidence of low intakes of riboflavin and folate especially in the oldest women. There was also a higher proportion with low status for some vitamins than in the free-living group. Mean serum folate concentration was significantly lower than in the free-living group and 39% of participants had a concentration below 7nmol/l. Sixteen percent of the group overall had red cell folate levels indicating severe deficiency while 29% of men and 15% of women had marginal status. Low vitamin C status was found in around 40% of participants and low riboflavin status in 41% of men and 32% of women.

ⁱⁱⁱ There are issues with the activation coefficient used to define those subjects who have marginal riboflavin status.

183. Vitamin D status was significantly lower in the institution group than in the free-living group. Over a third of men and women had low status and there was no evidence of seasonal variation. Vitamin D intakes from food sources were below the RNI in almost all participants and the contribution from supplements was low.

Minerals (Tables 21 & 22)

184. Taking the age groups together, mean intakes of potassium and magnesium fell below the RNI for men and women in the free-living group and additionally copper for women. Magnesium intakes below the LRNI were found in a fifth of the free-living group overall and over a third of the oldest group. Potassium intakes below the LRNI were found in 17% of men and 39% of women, increasing to 57% of women aged 85 and over.
185. Low iron intakes were found in 6% of women overall and 10% aged 85 and over. Although iron intakes in men were adequate, low haemoglobin levels were found in 11% of men overall and 37% in the 85+ group. Comparable figures for women were 9% and 16%.
186. Low zinc intakes were found in 8% of men and 5% of women overall, increasing to 15% of men and 10% of women in the oldest group. Low calcium intakes were found in 9% of women overall and 15% of the oldest group.
187. The institution group also had a high proportion with intakes below the LRNI for magnesium and potassium and to a lesser extent for zinc. Iron intake in the institution group was similar to that in the free-living group but the proportion with low iron status was higher. Over half the men and 40% of women in institutions had low haemoglobin levels.

Children and young people 1½-18 years

Vitamins (Tables 20, 23 & 24)

188. Mean intakes of all vitamins except vitamin A were above RNIs. Mean vitamin A intakes were close to or above the RNI in younger children but below the RNI in older groups. A fifth of 11-14 year old girls and 13% of boys in the same age group had vitamin A intakes below the LRNI, as did 12% of boys and girls aged 15-18. However there was little evidence of low vitamin A status based on plasma retinol levels³⁴ except in the 1½-4½ year group. The main food sources of vitamin A in 4-18 year olds were vegetables, providing about a quarter of average intake and milk and milk products, providing about a fifth.

189. Intakes were below the LRNI for riboflavin in 6% of boys and a fifth of girls in the 11-18 age groups. Raised levels of EGRAC, indicating marginal riboflavin status, were found in a high proportion of this age group^{iv}.
190. Mean vitamin D intake from food for children under 4 years was 18% of the RNI. However there was no evidence of low status in this group. In older children status indices for vitamin D indicate that 13% of 11-18 year-olds had low status (below the normal adult range ¹⁷⁴ⁱ). This proportion increased in the winter months.
191. Although dietary intakes of vitamin B₆ appear to be adequate, raised EAATAC levels^{v39} indicating deficiency were found in 10% of the 4-18 year age group. Low levels of serum B₁₂³⁹ were also found in 8% of 15-18 year old girls although intakes were adequate.
192. Secondary analysis of the NDNS dataset for 4-18 year-olds⁴² found that high consumers (the top third of population) of breakfast cereals had better folate, vitamin B₁₂ and riboflavin status; there was also an association with thiamin and vitamin B₆ status in girls. The author found that there was no difference in iron status between groups, possibly due to lower meat intakes in high consumers of cereal.

Minerals (Table 21, 22)

193. Mean intakes of most minerals in young children were above the RNI, with the exception of iron in the under 4s, and zinc. However, in the older groups, mean intakes for a number of minerals were below the RNI: zinc in all groups, potassium, magnesium and calcium in older boys and girls, and iron and copper in older girls. Significant proportions of 11-18 year olds had intakes below the LRNI for potassium, magnesium and zinc, and for older girls, iron, calcium and iodine.
194. Sixteen percent of children under 4 years had iron intakes below the LRNI (data collected in 1992) but intakes below the LRNI in the 4-6 age group were negligible (data collected in 1997). A substantial proportion of both age groups was anaemic and/or had low iron stores. In 11-14 and 15-18 year old girls, 45% and 50% respectively did not meet the LRNI and 14% and 27% had low serum ferritin levels.

^{iv} There are issues with the activation coefficient used to define those subjects who have marginal riboflavin status.

^v Erythrocyte Aspartate Aminotransferase Activation Co-efficient (EAATAC) is a measure of the saturation of a red cell enzyme with a co-factor derived from vitamin B₆.

195. Further analysis of the data⁴³ found that 30% of girls aged 11-18 had at least one indicator of low iron status, low haemoglobin, ferritin or transferrin saturation levels. It was found that eating red meat, fruit and fruit juice and salads were positively correlated with iron status while drinking more than one cup of tea a day and the onset of menarche were negatively correlated with iron status.
196. Further analysis of the NDNS 1½-4½ year dataset⁴⁴ found that dietary iron intake from food sources was only related to iron status in children with the lowest iron status. The key dietary variables for haemoglobin were vitamin C and copper (positively associated) and polyunsaturated fats (negatively associated). Polyunsaturated fats were also negatively correlated with ferritin levels. Another secondary analysis⁴⁵ found that adolescent girls who were non-Caucasian or vegetarian had significantly poorer iron status than Caucasians or meat eaters.
197. Intakes of zinc were low across the age group. Further analysis of the NDNS 4-18 data⁴⁶ found that low zinc intakes were consistently more prevalent in children with a poor self-reported variety of foods in the diet and appetite rating. In addition, low intakes were less prevalent in girls aged 11-18 who consumed higher amounts of breakfast cereals.

Overview of micronutrient intakes and status

198. Mean intakes of vitamins were above the RNI in all age groups except for vitamin A, which fell below the RNI for children and young adults. Vitamin A intakes below the LRNI were found in a substantial proportion of children and adults although there was no evidence of low status based on plasma retinol levels. Intakes below the LRNI were also found for riboflavin in older children, young adults and older people.
199. Evidence of low vitamin D status was found in most population age groups, especially older children and young adults, and older people living in institutions. Almost a third of young women of childbearing age (19-24 years) appear to have low status. The conventional cut-off for defining the lower limit of adequacy of vitamin D status, as used in NDNS, has been questioned and higher thresholds have been proposed⁴⁶. It is therefore possible that NDNS may be underestimating the prevalence of low vitamin D status.
200. Mineral intakes were generally lower in relation to the DRVs than vitamin intakes. Intakes of magnesium and potassium were low in all age groups

except young children, while a pattern of low intakes of several other minerals including calcium, zinc and iodine was seen in older children and young adults, particularly women.

201. Total iron intakes in girls and women of childbearing age were low compared with the DRVs. Up to 50% of some age groups had intakes below the LRNI. Status indices (total haemoglobin, percentage iron saturation and serum ferritin) suggest that a smaller proportion of females in the 11-49 age range have a low status than is indicated by the consumption data, although the numbers of both males and females with low status are still significant.
202. The inclusion of dietary supplements increased mean intakes of most vitamins and some minerals, but had little effect on the proportions with intakes below the LRNI, indicating that supplements are generally taken by those who have adequate micronutrient intakes from food.

Table 20: Mean intakes of vitamins from food as a percentage of Reference Nutrient Intake (RNI) and percentage below the Lower Reference Nutrient Intake (LRNI), by age and sex.

	Males and females Age (years)			Males aged (years)					
Vitamin	1½-4	4-6		7-10		11-14		15-18	
	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI
Vitamin A (retinol equivalents) (µg)	128	8	114	8	101	9	93	13	88
Thiamin (mg)	154	0	181	-	202	-	189	0	173
Riboflavin (mg)	197	0	194	-	162	1	144	6	148
Niacin equivalents (mg)	197	-	207	-	216	0	200	0	203
Vitamin B ₆ (mg)	170	1	189	-	194	-	182	1	180
Vitamin B ₁₂ (µg)	560	-	499	-	395	-	372	0	330
Folate (µg)	184	0	191	-	141	-	123	1	152
Vitamin C (mg)	160	1	223	-	243	-	218	-	208
Vitamin D (µg) ¹	18	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Number of subjects (unweighted)	1457		184		256		237		179
				Females aged (years)					
Vitamin	4-6		7-10		11-14		15-18		
	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	
Vitamin A (retinol equivalents) (µg)	112	6	96	10	78	20	91	12	
Thiamin (mg)	163	-	182	-	200	1	172	2	
Riboflavin (mg)	175	-	137	1	120	22	118	21	
Niacin equivalents (mg)	186	-	195	-	205	-	180	1	
Vitamin B ₆ (mg)	169	-	174	1	190	1	150	5	
Vitamin B ₁₂ (µg)	446	-	347	1	270	1	225	2	
Folate (µg)	169	-	126	2	102	3	105	4	
Vitamin C (mg)	217	0	245	-	202	1	185	0	
Vitamin D (µg) ¹	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Number of subjects (unweighted)	171		226		238		210		

¹ Vitamin D is also obtained from the action of sunlight on the skin. There are no DRVs specified for vitamin D intake for children aged 4 years and over.

Table 20 (continued) : Mean intakes of vitamins from food as a percentage of Reference Nutrient Intake (RNI) and percentage below the Lower Reference Nutrient Intake (LRNI), by age and sex.

Vitamin	Males aged (years)							
	19-24		25-34		35-49		50-64	
	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI
Vitamin A (retinol equivalents) (µg)	80	16	103	7	141	5	164	4
Thiamin (mg)	160	2	232	0	204	0	230	1
Riboflavin (mg)	129	8	163	1	168	2	169	3
Niacin equivalents (mg)	232	-	272	-	270	0	279	0
Vitamin B ₆ (mg)	189	-	211	0	206	2	201	1
Vitamin B ₁₂ (µg)	296	1	395	-	465	0	485	0
Folate (µg)	151	2	173	-	171	0	181	-
Vitamin C (mg)	162	-	185	0	221	-	236	-
Vitamin D (µg) [†]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Number of subjects (unweighted)	61		160		303		242	
Vitamin	Females aged (years)							
	19-24		25-34		35-49		50-64	
	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI
Vitamin A (retinol equivalents) (µg)	78	19	98	11	112	8	136	5
Thiamin (mg)	181	-	194	2	190	1	200	1
Riboflavin (mg)	126	15	131	10	151	5	159	6
Niacin equivalents (mg)	246	2	240	-	263	1	270	0
Vitamin B ₆ (mg)	165	5	158	1	170	2	177	2
Vitamin B ₁₂ (µg)	266	1	264	1	325	1	378	0
Folate (µg)	114	3	117	2	128	2	134	2
Vitamin C (mg)	170	1	181	-	200	0	236	0
Vitamin D (µg) [†]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Number of subjects (unweighted)	78		211		379		290	

† Vitamin D is also obtained from the action of sunlight on the skin. No DRV is set for adults.

Table 20 (continued): Mean intakes of vitamins from food as a percentage of Reference Nutrient Intake (RNI) and percentage below the Lower Reference Nutrient Intake (LRNI), by age and sex.

Vitamin	Males aged (years)									
	65-74 Free-living		75-84 Free-living		85+ Free-living		65-84 Institution		85+ Institution	
	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI
Vitamin A (retinol equivalents) (µg)	173	4	160	6	149	2	147	1	157	-
Thiamin (mg)	170	-	179	1	174	1	n/a	1	168	1
Riboflavin (mg)	137	4	130	5	126	5	133	3	146	2
Niacin equivalents (mg)	208	-	215	1	199	0	N/A	-	194	0
Vitamin B6 (mg)	169	2	167	1	150	3	N/A	1-2	150	1
Vitamin B12 (µg)	427	-	367	1	320	-	327	-	333	-
Folate (µg)	141	0	125	1	117	4	117	4	118	5
Vitamin C (mg)	179	1	148	3	127	2	123	-	127	2
Vitamin D (µg) [†]	43	N/A	38	N/A	32	N/A	36	N/A	41	N/A
Number of subjects (unweighted)	271		265		96		128		76	
Vitamin	Females aged (years)									
	65-74 Free-living		75-84 Free-living		85+ Free-living		65-84 Institution		85+ Institution	
	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI
Vitamin A (retinol equivalents) (µg)	161	4	165	5	152	4	156	1	164	-
Thiamin (mg)	153	-	166	-	157	1	n/a	-	153	0
Riboflavin (mg)	133	10	128	9	117	15	155	-	141	6
Niacin equivalents (mg)	214	-	200	-	183	1	207	-	184	0
Vitamin B ₆ (mg)	170	2	150	2	140	6	170	-	150	0
Vitamin B ₁₂ (µg)	307	1	300	1	233	4	300	-	307	-
Folate (µg)	108	4	101	7	92	11	105	2	94	8
Vitamin C (mg)	168	1	136	1	122	4	129	-	111	0
Vitamin D (µg) [†]	30	N/A	30	N/A	23	N/A	33	N/A	33	N/A
Number of subjects (unweighted)	256		217		170		91		117	

[†] Vitamin D is also obtained from the action of sunlight on the skin.

Table 21: Mean intakes of minerals from food sources as a percentage of Reference Nutrient Intake (RNI) and percentage with intakes below the Lower Reference Nutrient Intake (LRNI), by age and sex.

Mineral	Males and females aged (years)		Males aged (years)							
	1½- 4		4-6		7-10		11-14		15-18	
	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI
Total iron (mg)	77	16	134	—	111	1	95	3	111	2
Calcium (mg)	183	1	157	3	135	2	80	12	88	9
Magnesium (mg)	159	0	143	3	47	2	78	28	85	18
Potassium (mg)	187	0	177	—	107	—	77	10	81	15
Zinc (mg)	87	14	85	12	88	5	79	14	92	9
Iodine (µg)	170	3	156	2	140	1	124	3	139	1
Copper (mg)**	119	N/A	117	N/A	116	N/A	112	N/A	106	N/A
Number of subjects (unweighted)	1457		184		256		237		179	
Mineral	Females aged (years)									
	4-6		7-10		11-14		15-18			
	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI		
Total iron (mg)	119	1	96	3	60	45	58	50		
Calcium (mg)	146	2	119	5	80	24	82	19		
Magnesium (mg)	129	1	89	5	65	51	64	53		
Potassium (mg)	161	—	101	1	68	19	62	38		
Zinc (mg)	75	26	81	10	66	37	87	10		
Iodine (µg)	143	2	119	3	92	13	96	10		
Copper (mg)**	106	N/A	105	N/A	98	N/A	80	N/A		
Number of subjects (unweighted)	171		226		238		210			

** no LRNI set for copper

Table 21 (continued): Mean intakes of minerals from food sources as a percentage of Reference Nutrient Intake (RNI) and percentage with intakes below the Lower Reference Nutrient Intake (LRNI), by age and sex.

Mineral	Males aged (years)							
	19-24		25-34		35-49		50-64	
	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI
Total iron (mg)	131	3	150	0	157	1	156	1
Calcium (mg)	123	5	145	2	149	2	147	2
Magnesium (mg)	86	17	103	9	106	7	106	9
Potassium (mg)	81	18	94	3	99	5	101	5
Zinc (mg)	95	7	108	2	111	4	109	3
Iodine (µg)	119	2	154	1	158	2	164	1
Copper (mg)**	95	N/A	114	N/A	128	N/A	126	N/A
Number of subjects unweighted)	61		160		303		242	
Mineral	Females aged (years)							
	19-24		25-34		35-49		50-64	
	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI
Total iron (mg)	60	42	62	41	69	27	122	4
Calcium (mg)	99	8	104	6	114	6	118	3
Magnesium (mg)	76	22	77	20	87	10	91	7
Potassium (mg)	67	30	68	30	78	16	82	10
Zinc (mg)	98	5	96	5	108	4	112	3
Iodine (µg)	93	12	103	5	116	4	127	1
Copper (mg)**	76	N/A	83	N/A	88	N/A	89	N/A
Number of subjects unweighted)	78		211		379		290	

** no LRNI set for copper

Table 21 (continued): Mean intakes of minerals from food sources as a percentage of Reference Nutrient Intake (RNI) and percentage with intakes below the Lower Reference Nutrient Intake (LRNI), by age and sex.

Mineral	Males aged (years)									
	65-74 Free-living		75-84 Free-living		85+ Free-living		65-84 Institution		85+ Institution	
	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI
Total iron (mg)	128	—	124	2	120	4	110	4	110	5
Calcium (mg)	122	4	116	5	109	2	134	—	140	1
Magnesium (mg)	88	16	80	29	72	36	71	37	72	42
Potassium (mg)	81	14	72	23	66	34	70	27	69	28
Zinc (mg)	95	6	88	12	85	15	88	14	87	12
Iodine (µg)	137	1	129	2	119	4	139	1	137	2
Copper (mg)**	98	N/A	87	N/A	73	N/A	80	N/A	77	N/A
Number of subjects (unweighted)	271		265		96		128		76	
Mineral	Females aged (years)									
	65-74 Free-living		75-84 Free-living		85+ Free-living		65-84 Institution		85+ Institution	
	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI	Mean intake as % RNI	% below LRNI
Total iron (mg)	103	4	97	6	89	10	99	4	90	8
Calcium (mg)	101	8	97	10	92	15	129	1	118	1
Magnesium (mg)	77	19	69	27	66	34	74	16	66	27
Potassium (mg)	66	30	60	47	56	57	65	33	58	50
Zinc (mg)	100	3	96	7	91	10	107	1	96	6
Iodine (µg)	109	6	103	4	102	7	129	1	121	1
Copper (mg)**	76	N/A	69	N/A	66	N/A	72	N/A	68	N/A
Number of subjects (unweighted)	256		217		170		91		117	

** no LRNI set for copper

Table 22: Percentage of respondents below thresholds for iron status

Gender and age	Haemoglobin concentration	% Iron saturation	Serum ferritin	Number of subjects (unweighted)
	lower threshold for anaemia %	lower threshold for anaemia %	low iron stores %	
Males aged (years)				
1.5-4.5	7	n/a	24	475/- /467
4-6	3	23	18 ⁱ	86/60/69
7-10	47	18	14	185/150/147
11-14	30	19	17	181/166/153
15-18	1	12	5	164/149/131
19 – 24	–	6	4	45/45/45
25 – 34	2	13	0	119/115/119
35 – 49	4	3	6	245/243/245
50 – 64	3	6	5	210/206/210
65+ Free-living	11	6	7	495/467/477
65+ Living in an institution	52	21	11	147/134/141
Female aged (years)				
1.5-4.5	9	n/a	17	476/- /463
4-6	8	24	9 ^{††}	82/61/63
7-10	16	18	2	143/119/99
11-14	4	20	14	171/155/128
15-18	9	30	27	169/159/136
19 – 24	7	27	16	53/47/53
25 – 34	8	17	8	157/154/157
35 – 49	10	18	12	298/296/298
50 – 64	7	8	8	210/206/210
65+ Free-living	9	15	9	474/446/451
65+ Living in an institution	39	30	10	135/119/122

[†] percent less than 20µg/l; ^{††} percent less than 15 µg/l

Thresholds

Haemoglobin (g/dl)²⁸:

1½-6 years (male & female) <11.0

7 years + male <13.0

7 years + female <12.0

4 years + (male & female) <15

1½-4½ years (male & female) <10

7 years + male <20

7 years + female <15

Iron saturation %²²:

Serum ferritin (µg/l)²⁹

Table 23: Percentage of respondents with low status for water soluble vitamins

	Plasma vitamin C ²⁷	Red cell folate ²⁶		Serum folate ²⁷	Serum vitamin B ₁₂ ²⁹	Thiamin (ETKAC) ²²	Riboflavin (EGRAC) ²⁵	Vitamin B6 (EAATAC) ³⁰		Number of subjects (unweighted)
		severely deficient (<230 nmol/l)	marginal status (230-350 μmol/l)					Deficient (< 6.3 nmol/l)	Lower limit of normal range (< 118 pmol/l)	
		%	%	%	%	%	%	%		
Males aged (years)										
1.5-4.5	3**	n/d	n/d	n/d	n/d	n/a	19	n/a	n/a	380-421
4-6	5	—	3	—	—	1	59	7	7	69-86
7-10	2	1	3	—	—	—	78	8	8	165-185
11 – 14	1	1	7	—	—	0	80	11	11	172-181
15 –18	3	—	12	1	1	—	80	15	15	152-161
19 – 24	7	—	13	—	—	—	82	4	4	45
25 – 34	5	1	3	1	—	3	70	10	10	119
35 – 49	4	1	4	1	2	2	67	13	13	245
50 – 64	5	—	2	1	3	5	54	11	11	191
65+ Free-living	14	8	20†	16***	8	8	41	n/a	n/a	454-480
65+ Living in an institution	44	13	29†	40***	7	11	41	n/a	n/a	132-142

; ** Less than 10µmol/l; *** Less than 7nmol/l; † 230-345µmol/l

Table 23 (continued): Percentage of respondents with low status for water soluble vitamins

	Plasma vitamin C ²⁷	Red cell folate ²⁶		Serum folate ²⁷	Serum vitamin B ₁₂ ²⁹	Thiamin (ETKAC) ²²	Riboflavin (EGRAC) ²⁵	Vitamin B6 (EAATAC) ³⁰		Number of subjects (unweighted)			
		severely deficient (<230 nmol/l)	marginal status (230-350 μmol/l)					Deficient (< 6.3 nmol/l)	Lower limit of normal range (<118 pmol/l)		Biochemical deficiency (>1.25)	Marginal /deficient status (>1.3)	biochemical deficiency (> 2.0)
Females aged (years)													
1.5-4.5	2**	n/d	n/d	n/d	n/d	n/a	27	n/a		364-407			
4-6	2	–	1	–	–	1	75	6		76-82			
7-10	3	1	8	–	–	2	85	11		125-138			
11 – 14	1	–	11	1	–	2	90	14		161-169			
15 – 18	4	1	13	1	8	3	95	8		156-169			
19 – 24	4	–	8	–	5	–	77	12		53			
25 – 34	3	–	4	–	5	1	78	8		157			
35 – 49	4	–	5	0	4	2	69	12		298			
50 – 64	3	0	6	–	3	1	50	13		210			
65+ Free-living	13	8	22†	14***	5	9	42	n/a		439-459			
65+ Living in an institution	38	18	15†	38***	10	15	32	n/a		116-122			

; ** Less than 10µmol/l; *** Less than 7nmol/l; † 230-345µmol/l

Table 24: Percentage of respondents with low status for fat soluble vitamins

	Plasma retinol ²²		Plasma 25-hydroxy vitamin D ²⁸	Tocopherol: cholesterol ratio ¹²	Number of subjects (unweighted)
	severely deficient (<0.35 µmol/l)	marginal status (0.35-0.7 µmol/l)	below lower limit of normal range (<25 nmol/l)	below lower limit of normal range (<2.25)	
	%	%	%	%	
Males aged (years)					
1.5-4.5	2*	11**	—	n/a	377-411
4-6	—	2	3	—	55-73
7-10	—	2	4	—	135-167
11-14	—	—	11	—	163-177
15-18	—	—	16	—	143-153
19 – 24	—	—	24	1	45
25 – 34	—	—	16	1	107-115
35 – 49	—	—	12	1	213-243
50 – 64	—	1	9	1	168-189
65+ Free-living	—	—	6	n/d	436-476
65+ Living in an institution	—	3	38	n/d	131-138
Female aged (years)					
1.5-4.5	2*	10**	1	n/a	360-405
4-6	—	3	2	—	49-76
7-10	—	2	7	—	108-133
11-14	—	—	11	—	145-164
15-18	—	0	10	—	155-162
19 – 24	—	—	28	—	44-47
25 – 34	—	—	13	2	146-154
35 – 49	—	—	15	1	278-296
50 – 64	—	—	11	3	191-206
65+ Free-living	—	0	10	n/d	416-451
65+ Living in an institution	—	—	37	n/d	113-120

* < 0.5 µmol/l

** 0.5 - 0.75 µmol/l

Salt (Table 25; Figure 6)

203. Sodium intakes are estimated from 24-hour urine collections as estimates based on dietary records exclude salt added at the table or in cooking and so underestimate actual intake. Sodium intakes based on 24-hour urine collections are available from the 1986/87 and 2000/01 surveys of adults. Average intakes of salt in 2000/01 were 9.5g/day overall (11g/day for men and 8g/day for women); well above 6g/day (the recommended maximum).

Figure 6a: Mean salt intakes in men in 1986/87 and 2000/01

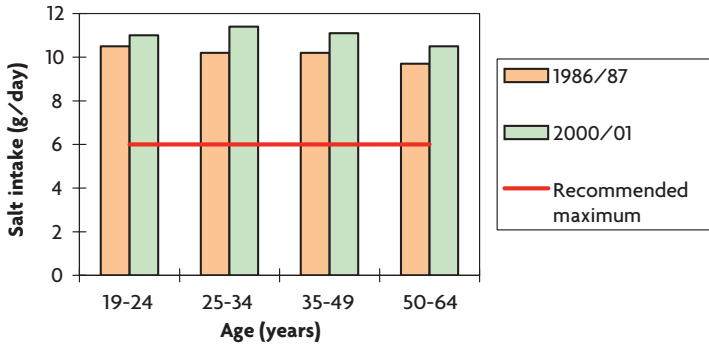
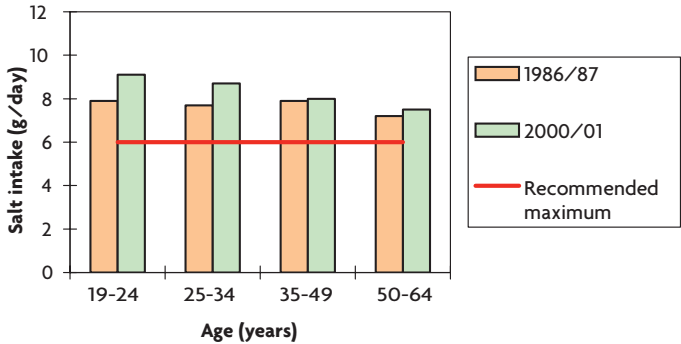


Figure 6b: Mean salt intakes in women in 1986/87 and 2000/01



204. The proportions of the population consuming less than 6g/day in 2000/01 were 15% of men and 31% of women. Men and women in the 19-24 age group were least likely to meet the target with only 2% and 17% consuming less than 6g/day, respectively. At the upper end of the distribution, 21% of men and 5% of women had an intake above 15g/day.
205. The average intake of salt increased from 9g/day in 1986/87 to 9.5g/day in 2000/01.
206. It is estimated that 75% of salt intake comes from processed foods. Of the remainder 10-15% comes from naturally occurring sodium in foods and 10-15% from discretionary salt added to food at the table or in cooking.

Table 25: Percentage distribution of salt intake (g/day) estimated from total urinary sodium

Salt intake (g/day)	Men aged (years)				All men		Women aged (years)				All women	
	19-24	25-34	35-49	50-64	cum %	cum %	19-24	25-34	35-49	50-64	cum %	cum %
	cum %	cum %	cum %	cum %			cum %	cum %	cum %	cum %		
3 or less	–	5	2	5	4	4	4	6	5	7	6	6
6 or less	2	20	13	18	15	15	17	29	31	38	31	31
9 or less	37	34	39	42	39	39	66	59	68	69	66	66
12 or less	60	57	58	65	60	60	84	81	85	91	86	86
15 or less	81	73	80	83	79	79	90	92	96	96	95	95
18 or less	100	89	91	91	91	91	92	97	100	99	98	98
All		100	100	100	100	100	100	100		100	100	100
Mean	11.0	11.4	11.1	10.5	11.0	11.0	91	8.7	8.0	7.5	8.1	8.1
Number of subjects (unweighted)	31	103	221	183	538	538	44	131	244	204	623	623

Oral health

Adults 19-64 years

207. The dental status of adults was assessed in the 2000/01 NDNS^{47,48}. Overall 5% of this age group were edentulous (no natural teeth) and a further 10% had between one and 20 teeth. Rates of edentulousness increased with age and number of teeth was associated with reported difficulty eating hard-to-chew foods. In the oldest age group (45-64 years) median fruit and vegetable intake was 290g/day in the dentate compared to 208g/day in the edentate.

Older adults aged 65 years and over

208. The NDNS of people aged 65 years and over included analysis of associations between oral health (in particular the presence of natural teeth) and diet and nutritional status⁴⁹. The survey found that better oral health, including how many natural teeth people had, was associated with better nutritional status. The condition of the mouth and the presence, number and distribution of natural teeth was related to the ease and ability to eat foods such as fresh fruit and uncooked vegetables and foods requiring more chewing. In the free-living group edentate respondents reported greater difficulty with eating a range of foods, for example apples, than did the dentate group. Ease of eating a range of foods was related to the number of natural teeth present and in particular the number of pairs of opposing teeth. The free-living edentate group had a lower mean energy intake than the dentate group (ns) and lower intakes of protein, NSP, iron, calcium, niacin equivalents and vitamin C. This group also had lower status levels for vitamins A, C and E.
209. Prevalence of poor oral health (particularly poor oral hygiene and root decay) was higher in the institution group than in the free-living group. There were few subjects with natural teeth in the institution group. Over half the group reported difficulty with eating foods such as nuts and raw carrots. There were fewer differences in nutrient intakes and nutritional status between the dentate and edentate groups than there were in the free-living group. The median plasma vitamin C level in the edentate group in institutions was 11.4µmol/l, close to the threshold for biochemical depletion (11µmol/l).

Children and young people aged 1½-18 years

210. The oral health component of the NDNS of children aged 1½-4½ years, carried out in 1992/93⁵⁰, found that 17% of children in this age group had some experience of dental decay, increasing to 30% in the 3½-4½ year age group.

Children in Scotland and the North of England had more decay than children in other parts of England and Wales. Half the 3½-4½ year age group in Scotland and 43% in Northern England had some experience of dental decay, compared with less than a quarter of children in the rest of England and Wales. Having a drink in bed every night was associated with increased decay experience in the 1½-2½ year and 2½-3½ year age groups. The frequency of consumption of sugar confectionery and carbonated drinks was related to dental decay in all age groups. For example, 40% of 3½-4½ year olds who had sugar confectionery most days or more often had experience of caries compared with just over a fifth of less frequent consumers of sugar confectionery.

211. An identical survey carried out as part of the 1997 NDNS of young people 4-18 years⁵¹ found that the proportion with dental decay increased from 37% in the 4-6 year group to 67% in the 15-18 year group. The prevalence of decay was highest in Scotland and lowest in London and the South East. Like the pre-school children there were links between the frequency of consumption of sugary foods and dental decay, but no significant associations were observed between the quantities of sugary foods consumed and dental caries.

Regional differences in diet and nutritional status

212. Generally the surveys show few clear regional trends or patterns in diet, nutrient intake or nutritional status. This is partly because the sample size in each region was sometimes too small for differences to reach statistical significance, particularly for Scotland.
213. There is some evidence of lower fruit and vegetable consumption in Scotland (and to a lesser extent Northern England) but this is not consistent across surveys. Children in Scotland were less likely to eat most types of vegetables (but not fruit) than children in other regions and older people (65 and over) in Scotland and the North were less likely to eat most types of fruit than those in other regions. The most recent survey of adults (2000/01) found no regional differences in consumption of fruit and vegetables overall, although women in Scotland and in the North ate fewer vegetables than women in London and the South East.
214. There were very few regional differences in intake of energy and macronutrients. Children and older people in Scotland had lower NSP intakes than other regions, probably reflecting low fruit and vegetable consumption. There was no regional difference in NSP intake in the most recent adults survey.

215. Regional differences in micronutrient intakes and status were more marked than those for macronutrients. Young children (1½-4½ years) in Scotland had the lowest mean intakes of vitamin C and total carotene and the lowest intakes of some minerals. However mean intakes of folate in this age group were lowest in London and the South East and Northern England. Further analysis of this dataset⁴⁴ found that higher proportions of children with combined low intakes of vitamin A, iron and zinc (7-9% compared to 2% overall) were found in parts of the North and in Scotland. Children in the North also had lower mean blood levels of water-soluble vitamins, e.g. vitamin C, than those in other regions, but the differences were not statistically significant. In the later survey of the 4-18 year group the differences were less marked. Children in Scotland had lower mean intakes of some vitamins compared to some other regions but there were few consistent patterns. Girls in the North had lower mean plasma vitamin C levels than those in other regions.
216. In the most recent survey of adults 19-64 years, there were very few regional differences in micronutrient intakes or status. There was some evidence of higher mean intakes in London and the South East than elsewhere for some vitamins, e.g. vitamin C for men, but there were no differences for minerals. There was also some evidence of lower blood levels of water soluble vitamins in Scotland compared with other regions, e.g. plasma vitamin C in men, serum folate in women. There were no significant regional differences in plasma 25-hydroxy vitamin D levels for men or women although the data suggest that mean levels tended to be lowest in Scotland and highest in the North. In the survey of older adults aged 65 years and over, mean plasma vitamin D levels were also lower among free-living men and women in Scotland and the North compared with other regions. Intakes of vitamin D, however, showed no significant regional variations, suggesting the difference in status was due to variation in sunlight exposure.

Socio-economic differences in diet and nutritional status

217. Comparisons of diets, nutrient intakes and nutritional status in people from lower and higher socio-economic status households (based on household receipt of benefits, social class and household income) show clear differences. People from lower socio-economic status households have different dietary patterns, in particular lower consumption of fruit and vegetables and also have lower intakes and blood levels of many micronutrients. Unless otherwise stated, differences refer to mean levels and a lower mean intake or blood level does not necessarily imply deficiency.

218. The 2000/01 survey of adults showed some marked differences in dietary patterns between adults in benefit households¹ and others. The benefit group had a much lower consumption of fruit and vegetables than the non-benefit group (2.1 portions a day for men and 1.9 for women in the benefit group compared with 2.8 portions a day for men and 3.1 for women in the non-benefit group). Those in benefit households were also less likely to eat high fibre breakfast cereals, oily fish and softgrain and other bread and were more likely to eat table sugar (men and women), whole milk, burgers and kebabs and meat pies (women only).
219. Findings in other age groups were similar. Young children (1½-4½ years) in manual social class households were half as likely to consume fruit juice than were their counterparts in non-manual households and were also less likely to eat fruit and salad vegetables, while the manual social class group were more likely to drink tea. Children aged 4-18 years from less advantaged households ate a smaller range of foods and were less likely to consume salad vegetables, fruit, some types of fruit juice and semi-skimmed milk.
220. Mean energy intakes are lower in lower socio-economic groups compared with other groups and so mean intakes of some macronutrients are also lower. Intakes of protein and NSP in particular tend to be lower in people from lower socio-economic households. There are few differences in the proportion of energy derived from the macronutrients. In the 2000/01 adults survey women in benefit households derived a higher proportion of energy intake from NMES and a lower proportion from protein than those in non-benefit households. Findings in other age groups are similar.
221. Adults living in households in receipt of benefits had lower average intake of many vitamins and minerals, compared with adults in non-benefit households. More than half (53%) of women aged 19 to 50 years living in benefit households had an iron intake from food sources below the LRNI, compared with about a third (29%) of those in non-benefit households. People living in households in receipt of benefits had lower status of some micronutrients on average, than people in non-benefit households, specifically vitamin C, folate, vitamin E and selenium for men and women and carotenoids and vitamin D for women.
222. Lower intakes of most vitamins were recorded for young children (1½-4½ years) from manual home backgrounds. When the intakes were adjusted for

¹ Benefit households are those households where one or more members were receiving Working Families Tax Credit at the time of the survey or had drawn Income Support or (income-related) job-seekers allowance in the previous 14 days.

differences between the groups in energy intake, the diets of children from manual backgrounds were found to have proportionately lower intakes of total carotene, niacin, vitamin B₁₂, vitamin C and E. Children from non manual home backgrounds tended to have higher average intakes of most minerals, but after adjusting for energy intakes only intakes of iron, calcium, phosphorus and potassium were significantly higher. The exceptions were sodium and chloride for which higher average intakes were recorded in the diets of children from manual home backgrounds, but the differences were not significant.

223. A further analysis project showed that low intakes of vitamin A, iron and zinc were associated consistently with lower socio-economic status in the 1½-4½ age group⁴⁴.
224. Older people in manual social class households also had lower mean intakes of vitamins and minerals and lower blood levels than those from non-manual households.

Low income diet and nutrition survey

225. The Food Standards Agency commissioned a Low Income Diet and Nutrition survey (LIDNS) to provide, for the first time, a single robust, representative, baseline dataset on food consumption, nutrient intake and nutritional status and factors affecting these in low-income/materially deprived consumers. Over 3,600 people, both adults and children, took part in the survey which was carried out throughout the UK between November 2003 and March 2005. The results²² showed that in many respects the areas of concern identified in the low income population are similar to those in the general population as described in this report, although some are more marked in the low income population. For example, mean fruit and vegetable consumption in the adult low income population was lower than in the general adult population as reported in NDNS (2.0 and 2.1 portions/day for men and women in LIDNS compared with 2.7 and 2.9 portions/day for men and women in NDNS. Mean fibre intake was also lower in low income adults than in the general population and mean intake of some minerals which fell below the RNI in both groups were lower in the low income population, e.g. iron in women. Intakes of fat and saturated fat in the low income adult population were similar to the NDNS.

Ethnicity

226. No information is available from the NDNS on diet and nutritional status in ethnic minority groups. The NDNS surveys are designed to be nationally

representative and the sample sizes are not large enough to permit separate analysis of ethnic minority groups.

Conclusions

227. The availability of data from the NDNS programme, in the form of a series of cross-sectional datasets on discrete population age groups, has enabled this comprehensive assessment to be made of the nutritional health of the British population. In particular the availability of two data points for adults from 1986/87 and 2000/01 has enabled changes in dietary habits and nutritional health to be assessed in this age group. The rolling programme structure planned for future NDNS will provide more frequent data points on each age group allowing a better assessment of trends in dietary behaviour.
228. The findings presented in this paper show a mixed picture of the diet and nutritional health of the population. While there is some evidence of positive dietary changes, especially the fall in fat and saturated fat intakes over the last fifteen years, there are a number of areas of concern, particularly for older children, young adults and people in lower socioeconomic groups. These groups tend to consume unbalanced diets with low consumption of fruit and vegetables in particular and show evidence of low intakes and status for a number of vitamins and minerals. This gives rise to concerns about the implications for the long term health of these groups.
229. Mean consumption of fruit and vegetables was below the five-a-day recommendation for adults in all age groups and was lowest in children, young adults and people in benefit households. Fruit and vegetable consumption was higher in 2000/01 than in 1986/87 for the 19-64 age group as a whole, the difference attributable to higher consumption in the older age groups. Consumption in the 19-24 age group was not higher in 2000/01. Oily fish consumption was below the recommendation of 1 portion a week in all age groups and was just over a third of a portion per week for adults. Soft drink consumption was substantially higher compared with the mid-1980s. Mean consumption in adults was 1.5 litres per week, while in children mean consumption was 2.8 litres per week in the 1½-4½ age group and over 3 litres per week in the 7-10 age group. Meat consumption was slightly higher in men in 2000/01 compared to 1986/87 but the major contributor had changed from beef to chicken and turkey.

- 230. Data from the most recent survey of adults (2000/01) shows a lower proportion of energy derived from fat and saturated fat and a higher proportion from total carbohydrate and protein than in the 1986/87 survey.
- 231. Mean intakes of total fat were generally close to the DRV in all population groups while intakes of saturated fat exceeded the DRV in all groups. The fall in total and saturated fat intakes is also reflected in the fall in plasma total cholesterol and LDL cholesterol levels between 1986/87 and 2000/01. This demonstrates the positive effect of dietary changes reducing fat and saturated fat intake leading to beneficial effects on blood lipid profile and reduction in cardio-vascular disease risk. Conversely there is evidence of a fall in HDL cholesterol levels in younger adults, especially men, and an increase in the total: HDL cholesterol ratio which is associated with increased cardio-vascular disease risk.
- 232. Mean intakes of non-milk extrinsic sugars exceeded the DRV for most population groups and were particularly high in children and young adults (mainly from soft drinks) and elderly people living in institutions (mainly from table sugar).
- 233. Alcohol made a significant contribution to energy intake in some consumers and a substantial proportion of adults exceeded the sensible drinking recommendations.
- 234. Non-starch polysaccharide intakes were low in all age groups.
- 235. Girls aged 11 upwards and young women and teenage boys and young men, particularly those aged under 25, are more likely than other groups to have low intakes of vitamins and minerals, including vitamin A, riboflavin, iron, potassium and magnesium. This is likely to be at least partly due to lack of variety in the diet, including low consumption of fruit and vegetables and high intakes of sugar and alcohol leading to diets of low nutrient density. There was also evidence of low status in the 15-18 age group for folate and in girls for vitamin B₁₂.
- 236. Low intakes of some vitamins and minerals were seen in older adults aged over 65, both the free-living and institution groups. There was evidence of low status for some B vitamins, vitamin C and folate, iron and zinc, particularly in the institution group. Diet and nutritional status was clearly associated with oral health in this age group, in particular the number of natural teeth.

- 237. Evidence of low vitamin D status was found in most population age groups especially in a proportion of older children and young adults, and in elderly people living in institutions.
- 238. Low iron intakes were found in young children (under 5 years), in some teenage girls and young women and in older adults, particularly those living in institutions. Evidence of low iron status was also seen in these groups.
- 239. The data showed marked differences in diet and nutritional status associated with socio-economic status. Fruit and vegetable consumption was lower in those in benefit households and those from manual social class groups. Both adults and children living in benefit households were more likely to have low intakes (below LRNI) of vitamins and minerals and there was some evidence of lower micronutrient status in this group. Poor oral health, which is associated with low socio-economic status, is a risk factor for poor diet and nutritional status.
- 240. Few regional differences were seen in diet or nutritional status. Because of small sample sizes it is not possible to conclude from the NDNS whether such differences exist. There is evidence from the surveys of some age groups for lower consumption of fruit and vegetables and lower intakes and status of some micronutrients in Scotland and Northern England than elsewhere. However these differences were inconsistent and were not found in the most recent survey of adults.

Section I Recommendation

- 241. The findings above indicate that action is needed to improve the overall diet of the population in order to reduce the risk of nutrition-related disease. This could be achieved by improvements to the balance of foods in the diet. It is recommended that high priority continues to be given to work in this area, specifically to promote increased consumption of fruit and vegetables and fish (especially oily fish), to limit consumption of high saturated fat / high sugar foods such as soft drinks and confectionery and to reduce salt intakes and to improve vitamin D status. This work needs to focus in particular on children, young adults and lower socio-economic groups. There is also a need to improve the quality of the diet for older people living in institutions as the nutritional status of this group is particularly poor. There is a need to promote uptake of the long established recommendation for vitamin D supplements to achieve DRVs in at risk groups (see Table 1)¹⁶.

3 SECTION II: ANALYSIS OF THE MICRONUTRIENT INTAKE AND STATUS OF BRITISH ADULTS

Aim

242. This section reports on the further analysis of data from the recent National Diet and Nutrition Survey (NDNS) of Adults (2000/01)⁴⁻⁸ with the aim of determining the dietary and non-dietary characteristics of those with low micronutrient intakes and/or status (i.e. biochemical status), with a view to providing information that could be used to help improve the micronutrient intake and/or status of this population sub-group. This secondary analysis addresses one of the targets in the Agency's Strategic Plan for 2005-2010: to seek expert advice on the health implications of low micronutrient intakes in some population groups in order to inform nutrition policy.

Background

243. Primary analysis of data from the NDNS of adults aged 19-64 years as published^{5,6} has shown that, based on a comparison of nutrient intakes with the UK Dietary Reference Values⁹ (DRVs), adults are generally getting sufficient nutrients from their diets. However, some sub-groups, in particular young women, to a lesser extent young men, and people living in households in receipt of state benefits, are more likely to have low intakes of vitamins and minerals.
244. This secondary analysis of the nutrient intake and status data was undertaken to focus on the vitamins and minerals for which a relatively highⁱⁱ proportion of adults had low intakesⁱⁱⁱ and/or status. Low intakes were seen for vitamin A, vitamin B₂, iron, calcium, magnesium, potassium, zinc and iodine. Of those for which status markers are available, evidence of low status^{iv} was seen for vitamin B₁, vitamin B₂, vitamin B₆, vitamin B₁₂, vitamin C, folate, iron and vitamin D. The aim was to determine the dietary and non-dietary characteristics of those with intakes of vitamins and minerals classified as 'low' or 'borderline' during the seven day dietary recording period, and the dietary and non-dietary characteristics of those with 'low' or 'marginal' status for vitamins and minerals, based on the analysis of blood samples for a range of biochemical indices.

ⁱⁱ It is not possible to give a single precise figure owing to the range of nutrient intake/status indices involved. Further detail on the proportion of adults with low intakes and/or status for each nutrient can be found in the NDNS Adults reports^{3,4}

ⁱⁱⁱ 'Low' defined as intakes less than the Lower Reference Nutrient Intake (LRNI)

^{iv} Blood analytes used to assess nutrient status were compared with cut-offs to identify those with low status

245. Two additional analyses were also undertaken to supplement the main analysis referred to above, that is, a quintile analysis, and principal component analysis (PCA).

Analysis to determine the characteristics of adults with low micronutrient intakes and/or status based on DRV and nutritional status cut-offs

Method

246. Average seven-day intakes of the micronutrients listed in Table 26 (from all sources i.e. food and dietary supplements) were compared with DRVs. 'Low' intakes^v were defined as below the Lower Reference Nutrient Intake (LRNI). 'Borderline' intakes were defined as at or above the LRNI but less than the Estimated Average Requirement^{vi} (EAR), except for iodine and potassium. 'Borderline' intakes for iodine and potassium were defined as at or above the LRNI but below the Reference Nutrient Intake^{vii} (RNI) as there is no EAR set for these nutrients.
247. Table 27 shows the blood analytes used to assess nutrient status compared with cut-offs used in the NDNS Adults aged 19-64 years and literature sources^{viii} to identify those with 'low' and 'marginal' status for these nutrients.

^v The Lower Reference Nutrient Intake (LRNI) represents the amount of a nutrient which is likely to meet the needs of 2.5% of the population

^{vi} The Estimated Average Requirement (EAR) is the intake which is likely to meet the needs of 50% of the population

^{vii} The Reference Nutrient Intake (RNI) is the intake which is considered sufficient to meet the requirements of 97.5% of the population

^{viii} All status cutoffs used as per NDNS Adults aged 19-64 years, except for EGRAC >1.8 indicating vitamin B2 deficiency: Table 7.2: Margetts & Nelson, *Design Concepts in Nutritional Epidemiology*, Oxford University Press (London: 1997)

Table 26: Nutrient Intakes - Cut-offs used for 'Low' and 'Borderline' intakes used in the analysis

NUTRIENT	UNIT	AGE/SEX	INTAKE - CUT-OFFS	
			'LOW' INTAKE	'BORDERLINE' INTAKE
			Less than the LRNI	At or above the LRNI but less than the EAR
Vitamin A (retinol equivalents)	µg/day	Men	<300	300 to <500
		Women	<250	250 to <400
Vitamin B ₂	mg/day	Men	<0.8	0.8 to <1.0
		Women	<0.8	0.8 to <0.9
Total iron	mg/day	Men	<4.7	4.7 to <6.7
		Women: 19-50yrs	<8.0	8.0 to <11.4
		Women 51-64yrs:	<4.7	4.7 to <6.7
Calcium	mg/day	Men & women	<400	400 to <525
Magnesium	mg/day	Men	<190	190 to <250
		Women	<150	150 to <200
Potassium	mg/day	Men & women	<2000	[2000 to <3500] ^a
Zinc	mg/day	Men	<5.5	5.5 to <7.3
		Women	<4.0	4.0 to <5.5
Iodine	µg/day	Men & women	<70	[70 to <140] ^a

^a No EARs have been set for potassium or iodine. Cut-off for 'borderline' intakes has therefore been set as at or above the LRNI but less than the RNI.

Table 27: Status indices - Cut-offs used for 'low' or 'marginal' status used in the analysis

NUTRIENT	STATUS INDEX	'LOW' STATUS	'MARGINAL' STATUS
Thiamin (vitamin B ₁)	ETKAC (Erythrocyte transketolase activation coefficient)	Levels >1.25 (indicating biochemical thiamin deficiency)	Not applicable
Riboflavin (vitamin B ₂)	EGRAC (Erythrocyte glutathione reductase activation coefficient)	Levels >1.8 (indicating deficiency)	Levels >1.3 (indicating marginal status)
Vitamin B ₆	EAATAC (Erythrocyte aspartate aminotransferase activation coefficient)	Levels >2.00 (indicating biochemical vitamin B ₆ deficiency)	Not applicable
Vitamin B ₁₂	Serum vitamin B ₁₂	Levels below 118pmol/l (lower level of normality)	Not applicable
Vitamin C	Plasma vitamin C	Levels below 11µmol/l (indicating biochemical depletion)	Not applicable
Folate	Red cell folate	Not applicable	Levels below <345nmol/l (indicating 'at least' marginal status)
Total iron	Serum ferritin	Levels below 20µg/l for men, and levels below 15µg/l for women (indicating low iron stores)	Not applicable
Vitamin D	Plasma 25-hydroxy vitamin D	Levels below 25nmol/l (lower limit of normal range)	Not applicable

248. Basic summary data was calculated to ascertain how many adults had low/ borderline intakes and/or low/marginal status for each variable. Chi-squared analysis was carried out on pairs of the intake variables to find the statistical association between them. Similarly, Chi-squared analysis was conducted on pairs of the status variables, and finally on pairs of variables where there was data available on both intake and status (i.e. vitamin B₂ and iron) to ascertain whether those people with low intakes also had low status.
249. As the aim of this analysis was to determine where the differences lay between people who had 'low/borderline' levels of intake and/or 'low/marginal' status, and people who had intakes/status above these levels, the smaller of these groups had to have a minimum subset size, to give meaningful results. This was set at 100. Two groups of 100 or more individuals were identified with either low, or borderline, intakes of vitamin A, magnesium and potassium

together. In addition, three separate groups of 100 or more individuals were identified with low/marginal status levels for vitamin B₂, B₆ or D, giving a total of five groups for analysis (see paragraph 251).

250. In addition, because vitamin D can be obtained through the action of sunlight on the skin, a separate analysis was undertaken to look at the characteristics of those adults with low status for vitamin D during the winter months compared with those adults with adequate status at this time of year, to minimise the influence of sunlight. Because of the effect of sunlight on vitamin D status we would expect a weaker relationship between intake and status for vitamin D during the summer months. This analysis was undertaken using wave 3 survey data, collected January-March. This was because, allowing for adequate sample size for analysis, there was a significant difference between the proportion of adults who had low status, and those who did not have low status for this variable, during these particular months.

251. The six groups identified were:

Adults aged 19-64 years with:

1. 'Low' intakes of vitamin A, potassium and magnesium (i.e. intakes <LRNI) (*124 adults out of a total sample size of 1724*)
 2. 'Borderline' intakes of vitamin A, potassium and magnesium (i.e. intakes at or above LRNI but below the EAR for vitamin A and magnesium, and above LRNI but below the RNI for potassium) (*328 adults out of a total sample size of 1600*)
 3. Low/Marginal vitamin B₂ status (EGRAC >1.3) (*801 adults out of a total sample size of 1237. Of these 801 adults, 777 had marginal status and 24 low status for vitamin B₂*)
 4. Low vitamin B₆ status (EAATAC >2.00) (*127 adults out of a total sample size of 1237*)
 5. Low vitamin D status (Plasma 25-hydroxyvitamin D <25nmol/l) (*166 adults out of a total sample size of 1232*)
 6. Low vitamin D status in the winter months (January-March) (plasma 25-hydroxyvitamin D <25nmol/l) (*61 adults out of a total sample size of 304*)
- a) For group 1 those with 'low' intakes (less than the LRNI) were compared to those with intakes above this level.

- b) For group 2 those with 'borderline' intakes of vitamin A and magnesium (i.e. intakes at or above the LRNI but less than the EAR) were compared to those with intakes at or above the EAR, whereas for potassium those with 'borderline' intakes (i.e. at or above the LRNI but less than the RNI) were compared to those with intakes at or above the RNI. This is because there is no EAR set for potassium.
 - c) For groups 3-6 those with 'low' or 'marginal' status for these vitamins (using the cut-offs given in Table 27) were compared with those with status above these cut-offs.
252. Comparisons were made to identify any significant differences in dietary and non-dietary characteristics. The statistical test used on the non-dietary characteristics was the 'Comparison Between Two Proportions' (due to the categorical nature of the data) and the statistical test used on the dietary characteristics was the 'Comparison of Two Means' (continuous data). These were two-sided tests and the significance levels looked at were 95% and 99% respectively. The characteristics included in the analysis were:

Non-dietary characteristics^{ix}

253. The other (mainly non-dietary) characteristics included in the analysis were: age, sex, Body Mass Index (BMI), receipt of benefits, vegetarian/vegan, slimming, had a long-standing illness or disability, were unwell during the seven day dietary recording period, whether they smoke, whether they consume alcohol, reported use of supplements^x, whether they use dentures, reported physical activity level. It was not possible to analyse the data according to ethnicity owing to small sample sizes.

Dietary characteristics^{xi}

254. The food groupings used to identify the dietary characteristics of adults with low intakes and/or status are provided in Table 28. This table shows how the existing NDNS food groups were aggregated for this analysis.
255. For this analysis the 'fruit and vegetables' group has been considered as a whole (i.e. fruit and vegetables including potatoes and fruit juice), but also split into specific components to allow more detailed analysis (e.g. vegetables (excluding potatoes), potatoes, fruit (excluding and including fruit juice), fruit juice).

^{ix} Using data from the dietary interview and anthropometric assessment

^x Includes supplements containing micronutrients, other types of dietary supplements and herbal preparations

^{xi} Using data from the seven-day dietary record

256. The 'dietary supplements' food group relates to the *number of dietary supplements consumed during the survey week only* (e.g. number of tablets, capsules etc). The resulting data does not, therefore, account for differences in the types of supplements consumed, the nutrients these dietary supplements may contain, or dose.
257. A very small group of adults (*12 adults out of a total sample size of 1724*) were also identified who had 'low' intakes (i.e. less than the LRNI) of all 8 vitamins and minerals listed in Table 26.

Table 28: Food Groups used in analysis

Existing food groups from the NDNS databank were aggregated for this analysis, and subgroups within these aggregated groups were highlighted for separate analysis where results from the NDNS Adults indicated that significant associations between these foods, and the micronutrients highlighted for this secondary analysis, may exist

NDNS Existing Food Groups	Food Groups Aggregated for this secondary analysis, and subgroups	
1A Pasta	Cereals and cereal products	Pizza
1B Rice		
1C Pizza		
1R Other cereals		Bread
2 White bread		
3 Wholemeal bread		
4A Softgrain bread		
4R Other breads		Breakfast cereals
5 Wholegrain & high fibre breakfast cereals		
6 Other breakfast cereals		
7 Biscuits		
8A Fruit pies		
8R Buns, cakes & pastries		
9A Cereal based milk puddings		
9B Sponge puddings		
9R Other cereal-based puddings		
10 Whole milk	Milk and milk products	Milk (liquid whole, semi-skimmed & skimmed)
11 Semi-skimmed milk		
12 Skimmed milk		
13A Infant formula		
13B Cream		
13R Other milk		
14A Cottage cheese		Cheese
14R Other cheese		
15A Fromage frais		
15B Yogurt		
15R Other dairy desserts		
53R Ice cream		

Table 28 (continued): Food Groups used in analysis

NDNS Existing Food Groups	Food Groups Aggregated for this secondary analysis, and subgroups	
16A Eggs	Eggs and egg dishes	
16B Egg dishes		
17 Butter	Fat spreads	
18A PUFA margarine		
18B PUFA oils		
19A PUFA low fat spread		
19R Low fat spread not PUFA		
20A Block margarine		
20B Soft margarine not PUFA		
20C Other cooking fats & oils not PUFA		
21A PUFA reduced fat spread		
21B Reduced fat spread not PUFA		
22 Bacon & ham	Meat and meat products	Liver and liver products
23 Beef, veal & dishes		
24 Lamb & dishes		
25 Pork & dishes		
26 Coated chicken & turkey		
27 Chicken & turkey dishes		
28 Liver, liver products & dishes		
29 Burgers & kebabs		
30 Sausages		
31 Meat pies & pastries		
32 Other meat & meat products		
33 White fish coated and/or fried	Fish and fish dishes	Oily fish
34A Other white fish & fish dishes		
34B Shellfish		
35 Oily fish		

Table 28 (continued): Food Groups used in analysis

NDNS Existing Food Groups	Food Groups Aggregated for this secondary analysis, and subgroups		
36A Carrots, raw	Fruit and vegetables (inc potatoes & fruit juice)	Vegetables (excluding potatoes)	Carrots
37E Carrots, not raw			
36B Salad and other vegetables (raw)			
36C Tomatoes, raw			
37A Peas, not raw			
37B Green beans, not raw			
37C Baked beans			
37D Leafy green vegetables, not raw			
37F Tomatoes, not raw			
37G Vegetable dishes, not raw			
37R Other vegetables, not raw			
38A Chips		Potatoes	
38B Other fried potatoes inc fried potato products			
38R Potato products, not fried			
39 Other potatoes, potato salads and dishes			
40A Apples & pears, not canned		Fruit (including fruit juice)	Fruit (excluding fruit juice)
40B Citrus fruit, not canned			
40C Bananas			
40D Fruit canned in juice			
40E Fruit canned in syrup			
40R Other fruit, not canned			
45 Fruit juice			
41A Sugar	Sugar, preserves and confectionery		
41B Preserves			
41R Sweet spreads, fillings, icings			
43 Sugar confectionery			
44 Chocolate confectionery			
42 Crisps and savoury snacks	Savoury snacks		

Table 28 (continued): Food Groups used in analysis

NDNS Existing Food Groups	Food Groups Aggregated for this secondary analysis, and subgroups	
47A Liqueurs	Alcoholic beverages	Beer and lager
47B Spirits		
48A Wine		
48B Fortified wine		
48C Low alcohol & alcohol free wine		
49A Beers & lagers		
49B Low alcohol & alcohol free beers & lagers		
49C Cider, perry		
49D Low alcohol & alcohol free cider & perry		
49E Alco-pops		
50A Beverages (dry weight)	Mis-cellaneous	
50B Soups		
50R Savoury sauces, pickles, gravies, Condiments		
52R Commercial toddlers foods		
52A Commercial toddlers drinks		
55 Artificial sweeteners		
51A Coffee (made up)	Tea, coffee and water	
51B Tea (made up)		
51C Herbal tea (made up)		
51D Bottled water		
51R Tap water		
54A Dietary supplements (tablets & capsules)	Dietary supplements	
54B Dietary supplements (oils & syrups)		
54C Dietary supplements (drops & powders)		
54R Nutritionally complete supplements		
56R Nuts & seeds	Nuts and seeds	
57A Concentrated soft drinks, not low calorie	Soft drinks (excluding fruit juice)	
57B Carbonated soft drinks, not low calorie		
57C Ready to drink soft drinks, not low calorie		
58A Concentrated soft drinks, low calorie		
58B Carbonated soft drinks, low calorie		
58C Ready to drink soft drinks, low calorie		

Results

258. The Chi-squared analysis identified that all nutrient intake variables were strongly associated with each other. For status, some but not all variables were associated with each other (12 of the 36 combinations). Only for vitamin B₂ and iron were both intake and status data included in this analysis. The Chi-squared analysis showed that there was no association between the group with low intake of vitamin B₂ when compared to the group with low/marginal status for this nutrient. Similarly, there was no association between low intakes and low status for iron.
259. For the results that follow, relationships between intake/status and dietary and non-dietary characteristics are only commented upon where associations are significant at $p < 0.01$. Other associations between low intakes/status and dietary/non-dietary characteristics were investigated but not found (e.g. vitamin D status and oily fish).

Non-dietary characteristics

260. Table 29 shows the non-dietary characteristics of adults with low/marginal status for vitamin B₂, low status of vitamin B₆ or vitamin D, and low/borderline intakes for vitamin A, potassium and magnesium.

Table 29: Non-dietary characteristics of adults with low/marginal status for vitamin B₂, low status for vitamin B₆ or vitamin D, and low/borderline intakes of vitamin A, potassium and magnesium

Non-dietary characteristics	Status			Intake of Vitamin A, Potassium & Magnesium	
	Low/ Marginal Vitamin B ₂ ^a	Low Vitamin B ₆ ^β	Low Vitamin D ^β	Low ^β	Border- line ^β
Higher proportion of women				✓	
Higher proportion of youngest age group, 19 to 24yrs	✓		✓	✓	✓
Higher proportion of age group 25 to 34yrs	✓				✓
Lower proportion of age group, 50 to 64yrs	✓			✓	✓
Less likely to drink alcohol			✓	✓	
Higher proportion of smokers	✓		✓	✓	✓
Less reported supplement use	✓		✓	✓	✓
Higher proportion unwell during survey week				✓	✓
More likely to be from household in receipt of benefits	✓		✓	✓	✓
Higher proportion vegetarian/ vegan			✓		
Less physically active			✓		

Key:

✓ = Significant at 99% confidence level (or $p < 0.01$)

^α = EGRAC (Erythrocyte glutathione reductase activation coefficient) > 1.3 compared with adults with EGRAC < 1.3

^β = EAATAC (Erythrocyte aspartate aminotransferase activation coefficient) > 2.00 compared with adults with EAATAC < 2.00

^γ = Plasma 25-hydroxyvitamin D below 25 nmol/l compared with adults with level above 25 nmol/l

^δ = Less than LRNI compared with adults with intakes at or above the LRNI

^φ = At or above LRNI to less than the EAR for vitamin A and magnesium. Compared with adults with intakes at or above the EAR. At or above LRNI to less than RNI for potassium compared to adults with intakes at or above the RNI (there is no EAR set for potassium)

Note: Analysis carried out on raw data (data not adjusted/standardised)

Groups 1 and 2: 'Low'ⁱ (n=124/1724) and 'Borderline'ⁱⁱ (n=328/1600) intakes of vitamin A, potassium and magnesium

261. Table 29 shows that the range of non-dietary characteristics for adults in the 'low' and 'borderline' groups were similar. Compared to the groups with intakes of vitamin A, potassium and magnesium above these levels, the groups with 'low' and 'borderline' intakes of vitamin A, potassium and magnesium contained a *significantly higher proportion of:*

- a) adults aged 19 to 24 years
- b) smokers
- c) those living in benefit households
- d) those who reported being unwell during the survey week

and a *significantly lower proportion of:*

- a) adults aged 50 to 64 years
- b) those who reported taking supplements

262. In addition, the group with 'low' intakes of vitamin A, potassium and magnesium contained a *significantly higher proportion of:*

- a) women

and a *significantly lower proportion of:*

- a) those who consumed alcohol

The group with 'borderline' intakes of vitamin A, potassium and magnesium contained a *significantly higher proportion of:*

- a) adults aged 25 to 34 years

Groups 3-5: Low/marginal Vitamin B₂ statusⁱⁱⁱ (n=801/1237), low vitamin B₆ status^{iv} (n=127/1237), or low vitamin D status^v (166/1232)

263. Table 29 shows that adults with low vitamin B₆ status did not have significantly different non-dietary characteristics compared with adults with vitamin B₆ status above this level.

ⁱ 'Low' defined as intakes <LRNI

ⁱⁱ 'Borderline' intakes defined as at or above the LRNI but below the EAR for vitamin A and magnesium, and above LRNI but below the RNI for potassium (there is no EAR set for potassium)

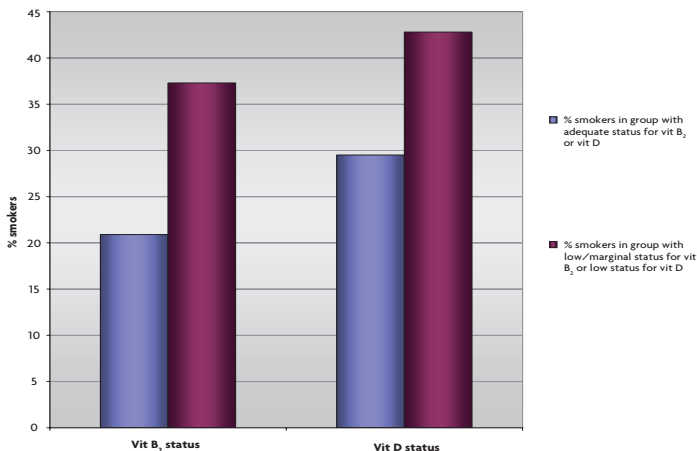
ⁱⁱⁱ Marginal vitamin B₂ status defined as EGRAC >1.3

^{iv} Low vitamin B₆ status defined as EAATAC >2.00

^v Low vitamin D status defined as plasma 25-hydroxyvitamin D <25nmol/l

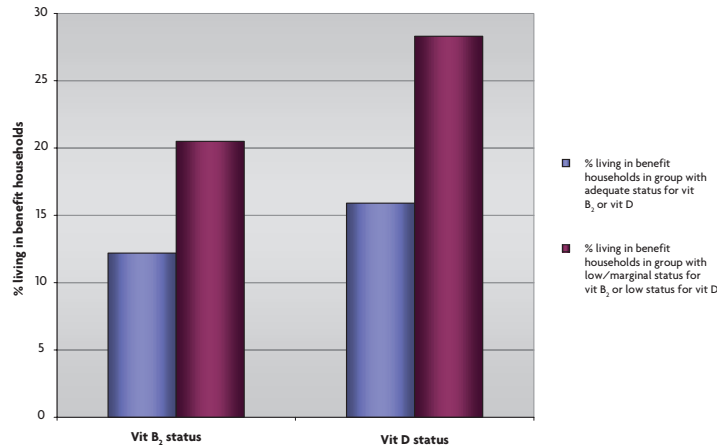
264. Compared to the groups with status above these levels for vitamin B₂ or D, the groups with **low/marginal status for vitamin B₂**, or **low status for vitamin D** contained a *significantly higher proportion of*:
- a) adults aged 19 to 24 years
 - b) smokers
 - c) those living in benefit households
- and a *significantly lower proportion of*:
- a) those who reported taking supplements
265. Figures A and B provide a graphical representation of the prevalence of smoking, and of adults living in households in receipt of benefits respectively, by status.
266. In addition, the group with **low/marginal vitamin B₂ status** contained a *significantly higher proportion of*:
- a) adults aged 25 to 34 years
- and a *significantly lower proportion of*:
- a) adults aged 50 to 64 years
267. Those with **low vitamin D status** contained a *significantly higher proportion of*:
- a) those who reported being vegetarian/vegan
- and a *significantly lower proportion of*:
- a) those who consumed alcohol
- and also reported being less physically active compared to adults with vitamin D status above this level.

Figure A: Prevalence of smoking in adults by status for vitamin B₂ and vitamin D



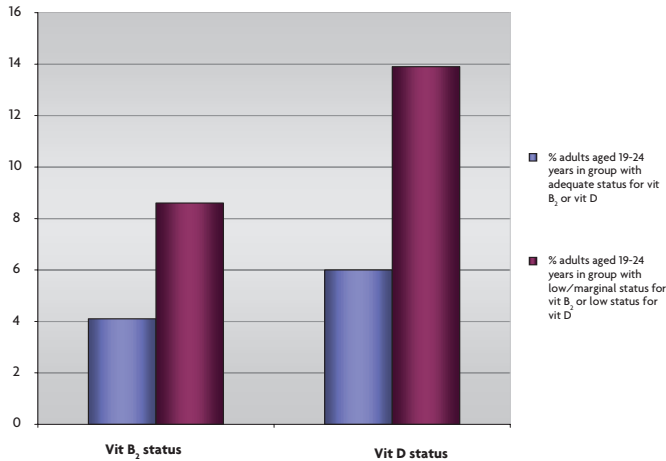
268 Figure C provides a graphical representation of the prevalence of low/marginal status for vitamin B₂ and low status for vitamin D for adults aged 19 to 24 years.

Figure B: Prevalence of adults living in benefit households by status for vitamin B₂ and vitamin D



Note: Analysis carried out on raw data (data not adjusted/standardised)

Figure C: Prevalence of adults aged 19-24 years by status for vitamin B₂ and vitamin D



Note: Analysis carried out on raw data (data not adjusted/standardised)

Dietary characteristics

269. Table 30 shows the dietary characteristics of adults with low/marginal status for vitamin B₂, low status for vitamin B₆ or vitamin D, and low/borderline intakes of vitamin A, potassium and magnesium.
270. The description of the dietary patterns that follow characterise the balance of foods consumed in the diets of those with low intakes and/or status. The results are organised according to whether those with low intakes/status are consuming 'less' or 'more' of a particular food group compared with those with adequate intakes/status. Some of the food groups identified are foods which are rich sources of the nutrient in question and lower consumption of these may explain, at least in part, the low intakes/status. Other food groups identified are not necessarily good sources of the nutrient, but lower consumption of these indicate a less healthy diet generally (e.g. fish, and fruit and vegetables). Other food groups consumed 'more' than by those with adequate intakes/status (e.g. savoury snacks and soft drinks excluding fruit juice) may be displacing other, more nutrient dense foods.

Table 30: Dietary characteristics of adults with low/marginal status for vitamin B₂, low status for vitamin B₆ or vitamin D, and low/borderline intakes of vitamin A, potassium and magnesium

Dietary characteristics	Status			Intake of Vitamin A, Potassium & Magnesium	
	Low/ Marginal Vitamin B ₂ ^α	Low Vitamin B ₆ ^β	Low Vitamin D ^γ	Low ^δ	Border- line ^φ
<i>Consume Less:</i>					
Cereals and cereal products	✓			✓	✓
• Pizza				✓	
• Bread				✓	✓
• Breakfast cereals	✓			✓	✓
Milk and Milk products	✓			✓	✓
• Milk (liquid whole, semi-skimmed and skimmed)	✓			✓	✓
• Cheese				✓	✓
Eggs and Egg dishes				✓	
Fat spreads			✓	✓	✓
Meat and meat products				✓	
• Liver and liver products				✓	✓
Fish and fish dishes	✓		✓	✓	✓
• Oily fish				✓	
Fruit and Vegetables (including potatoes and fruit juice)	✓		✓	✓	✓
• Vegetables (excluding potatoes)				✓	✓
• Carrots				✓	✓
• Potatoes				✓	
• Fruit (including fruit juice)	✓		✓	✓	✓
• Fruit (excluding fruit juice)	✓		✓	✓	✓
• Fruit juice				✓	✓
Sugar preserves and confectionery				✓	

Table 30 (continued): Dietary characteristics of adults with low/marginal status for vitamin B₂, low status for vitamin B₆ or vitamin D, and low/borderline intakes of vitamin A, potassium and magnesium

Dietary characteristics	Status			Intake of Vitamin A, Potassium & Magnesium	
	Low/ Marginal Vitamin B ₂ ^α	Low Vitamin B ₆ ^β	Low Vitamin D ^γ	Low ^δ	Border- line ^ϕ
Savoury snacks					
Alcoholic beverages		✓		✓	✓
• Beer and Lager		✓		✓	✓
Miscellaneous ^π					✓
Tea, coffee and water	✓			✓	✓
Dietary supplements ^θ	✓		✓	✓	✓
Nuts and seeds				✓	✓
Soft drinks (excluding fruit juice)					
Consume More:					
Savoury snacks	✓				
Soft drinks (excluding fruit juice)	✓				

Key: ✓ = Consume less (significant at 99% confidence or p< 0.01)

^α = EGRAC (Erythrocyte glutathione reductase activation coefficient) > 1.3 compared with adults with EGRAC <1.3

^β = EAATAC (Erythrocyte aspartate aminotransferase activation coefficient) > 2.00 compared with adults with EAATAC < 2.00

^γ = Plasma 25-hydroxyvitamin D below 25 nmol/l compared with adults with level above 25 nmol/l

^δ = Less than LRNI compared with adults with intakes at or above the LRNI

^ϕ = At or above LRNI to less than the EAR for vitamin A and magnesium. Compared with adults with intakes at or above the EAR. At or above LRNI to less than RNI for potassium compared to adults with intakes at or above the RNI (there is no EAR set for potassium)

^π = Includes soups, savoury sauces, pickles, gravies and condiments

^θ = The 'dietary supplements' food group relates to the *number of dietary supplements consumed during the survey week only* (e.g. number of tablets, capsules etc)

Note: Analysis carried out on raw data (data not adjusted/standardised)

Groups 1 and 2 'Low'ⁱ and 'Borderline'ⁱⁱ intakes of vitamin A, potassium and magnesium

271. Table 30 shows that the dietary characteristics of these adults were very similar.
272. Those adults with 'low' intakes of these micronutrients (i.e. below the LRNI) consumed significantly less of almost every food group compared with adults who had micronutrient intakes above this level. However, there was no difference between the two groups in consumption of savoury snacks, soft drinks (excluding fruit juice) and miscellaneous foods (such as soups, savoury sauces, pickles, gravies and condiments).
273. Those adults with 'borderline' intakes of vitamin A, potassium and magnesium had similar dietary characteristics to those with 'low intakes'. However, there was no difference in consumption of eggs and egg dishes, meat and meat products, sugar, preserves and confectionery, savoury snacks, soft drinks (excluding fruit juice), pizza, oily fish, and potatoes between adults with 'borderline' intakes of these micronutrients and adults with intakes above this level.

Groups 3-5: Low/marginal Vitamin B₂ statusⁱⁱⁱ, low vitamin B₆ status^{iv}, low vitamin D status^v

274. Table 30 shows that, compared with adults with adequate vitamin B₂ status, those **adults with low/marginal vitamin B₂ status consumed significantly less:**
 - a) cereals and cereal products
breakfast cereals
 - b) milk and milk products
milk (liquid whole, semi-skimmed and skimmed)
 - c) fish and fish dishes
 - d) total fruit and vegetables (including potatoes and fruit juice)
fruit (both including and excluding fruit juice)
 - e) tea, coffee and water
 - f) dietary supplements

ⁱ 'Low' defined as intakes <LRNI

ⁱⁱ 'Borderline' intakes defined as at or above the LRNI but below the EAR for vitamin A and magnesium, and above LRNI but below the RNI for potassium (there is no EAR set for potassium)

ⁱⁱⁱ Marginal vitamin B₂ status defined as EGRAC >1.3

^{iv} Low vitamin B₆ status defined as EAATAC >2.00

^v Low vitamin D status defined as plasma 25-hydroxyvitamin D <25nmol/l

and consumed significantly more:

- a) savoury snacks
- b) soft drinks (excluding fruit juice)

Milk and milk products for example are a good source of vitamin B₂, and some breakfast cereals are fortified with vitamin B₂.

275. *Those adults with low vitamin B₆ status consumed significantly less:*

- a) alcoholic beverages
beer and lager

276. *Those with low vitamin D status consumed significantly less:*

- a) fat spreads
- b) fish and fish dishes
- c) total fruit and vegetables (including potatoes and fruit juice)
fruit (both including and excluding fruit juice)
- d) dietary supplements

277. Consumption of fish and fish dishes overall by those with low vitamin D status was 73% of that consumed by adults with vitamin D status above this level (oily fish is a good source of vitamin D). Vitamin D is required by law to be added to margarine and is also added to most reduced and low fat spreads.

Group 6: 'Low' vitamin D status^{vi} in the winter months

278. Compared with adults who had adequate vitamin D status during the winter months (i.e. wave 3 of the survey: January to March), *adults who had low vitamin D status during January to March consumed significantly less:*

- a) fat spreads
- b) dietary supplements
- c) potatoes
- d) miscellaneous foods (such as soups, savoury sauces, pickles, gravies and condiments)

'Low'^{vii} intakes of all 8 micronutrients

^{vi} Low vitamin D status defined as plasma 25-hydroxyvitamin D <25nmol/l

^{vii} 'Low' defined as intakes <LRNI

279. This group consisted of a small group of women (12 out of a total sample of 1724) who were non-vegetarian. It was not possible to look in detail at the dietary characteristics of this particular group or draw any conclusions from these results owing to the small sample size. However, compared to those who do not have low intakes of these micronutrients, this group contained a higher proportion of smokers, those who use dentures, and those who had a long-standing illness, disability or infirmity, or were unwell during the survey week. These women were also more likely to live in a household in receipt of benefits, and to be underweight (BMI <18.5). However, owing to the very small sample numbers it is important to note that it is not possible to draw any conclusions from these differences.

Discussion

280. All nutrient intake variables were strongly associated with each other. That is, individuals with low intakes of one micronutrient listed in table 26 were also likely to have low intakes of the other micronutrients listed. Those with low/ borderline intakes of vitamin A, potassium and magnesium had significantly lower intakes of food energy compared to those with nutrient intakes above these levels ($p < 0.01$, data not shown). They were also more likely to have, on average, lower status for *almost all* the status variables initially identified for inclusion in the analysis at the 99% level of significance (except vitamin B₆ for those with low intakes (significant at 95% level), and vitamin B₆ and serum ferritin for those with borderline intakes (not significant (ns), data not shown)).
281. There was some evidence of an association between status variables when pairs of these were compared (12 of the 36 combinations). There was no significant difference in intakes of food energy by those with low/marginal status for vitamin B₂ or low status for vitamin B₆. However those with low status for vitamin D had lower intakes of food energy compared with those with status above this level ($p < 0.05$).
282. For vitamin B₂ and iron, both intake and status data were included in this analysis. There were no associations between the intakes and status for these nutrients. This may partly be due to the fact that nutrient intakes have been estimated from food consumption over seven days in this survey, while many measures of nutritional status reflect nutrient intakes over the longer term. In addition, an association between nutrient intake and status is not always expected. For example, iron status is also determined by key variables other than iron intake which have not been included in the analysis (such as loss of iron through menstrual blood loss).

283. Those adults with 'low' and 'borderline' intakes of vitamin A, magnesium and potassium consumed less of almost every food group compared to adults with intakes of these micronutrients above these levels.
284. There are some consistencies in the dietary characteristics of adults with low/marginal status for vitamin B₂, or low status for vitamin D. Low/marginal vitamin B₂ status and low D status were independently associated with lower consumption of fish and fish dishes, total fruit and vegetables (including potatoes and fruit juice), fruit (including and excluding fruit juice) and dietary supplements. Low vitamin D status was not independently linked to oily fish (which is a good source of vitamin D), only fish and fish dishes overall. This is probably due to the low consumption of oily fish (one third of a portion per week, on average overall). In addition, low/marginal vitamin B₂ status was associated with higher consumption of savoury snacks and soft drinks excluding fruit juice, suggesting that these foods may be displacing other foods rich in this nutrient e.g. milk. Low vitamin B₆ status was associated with lower consumption of alcoholic beverages as a whole, and beer and lager.
285. Low/borderline intake of vitamin A, potassium and magnesium and/or low/marginal status for vitamin B₂ and low status for vitamin D was more likely to be found in younger adults, smokers, those living in a household in receipt of benefits, and those who did not report taking supplements. It is important to note that those adults taking supplements tended to be those with higher intakes of these nutrients from food. Adults with low vitamin B₆ status did not have significantly different non-dietary characteristics compared with adults with vitamin B₆ status above this level.
286. Those adults with low intakes of vitamin A, potassium and magnesium and/or low status for vitamin D were less likely to drink alcohol. However, it is important to note that this reflects the higher prevalence of adults from benefit households in these groups. Adults living in households in receipt of benefits were significantly less likely than those in non-benefit households to have recorded consuming alcohol during the dietary recording period⁵.
287. Those with low status for vitamin D reported being less physically active compared with those who had adequate vitamin D status. Vitamin D is produced by the action of sunlight on the skin, and therefore this finding may be linked to low levels of outdoor (sunlight exposed) physical activity among this group. The results of the analysis of vitamin D status during the winter

months suggest that those who undertake limited outdoor activity would benefit from increasing the consumption of certain food groups, such as oily fish and fortified fat spreads.

288. Consideration was given to including plasma homocysteine levels in this analysis. High plasma homocysteine concentrations are moderately associated with increased risk of vascular diseases for example⁵² However, this analyte is sensitive to changes in status of certain B vitamins and was considered in the 2006 SACN report on folate and disease prevention⁵³.

Analysis by quintile

Method

289. The full dataset from the original analysis outlined in paragraphs 246 and 247 were re-calculated for presentation of main findings by quintile so the data could be presented in a more continuous form, and because a wider selection of variables could be considered (as there were no restrictions relating to sample size). To manage the quantity of results produced by this method effectively, initial comparisons were made to identify any significant differences in dietary and non-dietary characteristics between those with the lowest intakes and/or status (i.e. quintile 1) and those with the highest (quintile 5). An initial check of the full dataset confirmed that this methodology would allow for inclusion of all key results therein. These data were scrutinised further to identify results of particular interest for further investigation. These results were subjected to more detailed comparisons to determine significant differences by quintile. The statistical tests used were those outlined above for the original analyses (see paragraph 252).

Results

Non-dietary characteristics

290. Table 31 shows the non-dietary characteristics of adults with the lowest status for nutrients (i.e. quintile 1) compared with those with the highest status (quintile 5). Data in the shaded boxes highlight the main findings therein. That is, those non-dietary characteristics associated with low status for the majority of nutrients included in the analysis. Similar results had also been found for the previous analysis undertaken as described in paragraph 244. The relationship between iron status and gender was highlighted separately, owing to the particularly strong association found (*sequentially* through each quintile).

Table 31: Quintile analysis: Significant differences in the non-dietary characteristics between those with the lowest vs highest status for each nutrient ($p < 0.01$)

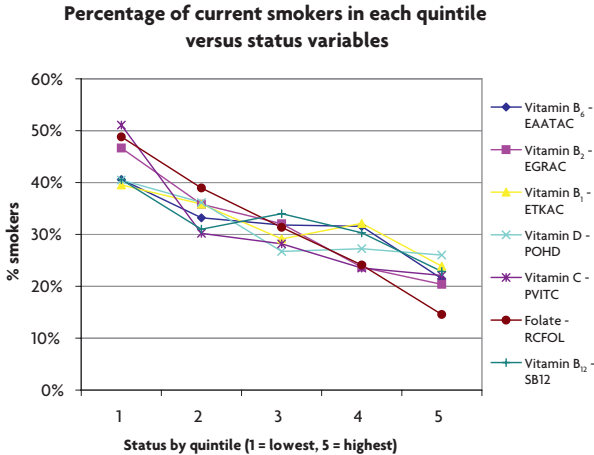
Non-dietary characteristics	Status							
	Iron	Vitamin D	Folate	Vitamin B ₁₂	Vitamin C	Vitamin B ₁	Vitamin B ₂	Vitamin B ₆
<i>Compared to those with the highest status (quintile 5) those with the lowest status (quintile 1):</i>								
Higher proportion of women	✓			✓				
Higher proportion of men					✓	✓		
Higher proportion of youngest age group, 19 to 24 years	✓	✓	✓				✓	
Higher proportion of age group 25 to 34 years	✓		✓				✓	
Lower proportion of age group 50 to 64 years	✓		✓				✓	
Higher proportion of vegetarian/vegan	✓			✓				
Less likely to drink alcohol	✓	✓						✓
Higher proportion of smokers		✓	✓	✓	✓	✓	✓	✓
Less likely to use dentures	✓							
More likely to use dentures					✓			
More likely to be from household in receipt of benefits	✓	✓	✓	✓	✓		✓	
Less physically active		✓			✓			
Less reported supplement use		✓	✓	✓	✓	✓	✓	✓
Higher proportion unwell during survey week		✓			✓			

Shaded data: key findings investigated further

Note: Analysis carried out on raw data (data not adjusted/standardised)

291. The key non-dietary characteristics associated with lower status were smoking, living in a household in receipt of benefits, and less reported supplement use. There was also evidence of low intakes/status in younger age groups for some nutrients, and, notably, lower iron intakes/status in women. These results were examined further and are presented in figures D-G).
292. These key results are also seen when the non-dietary characteristics of those with the lowest nutrient intakes are compared with those with the highest.

Figure D:



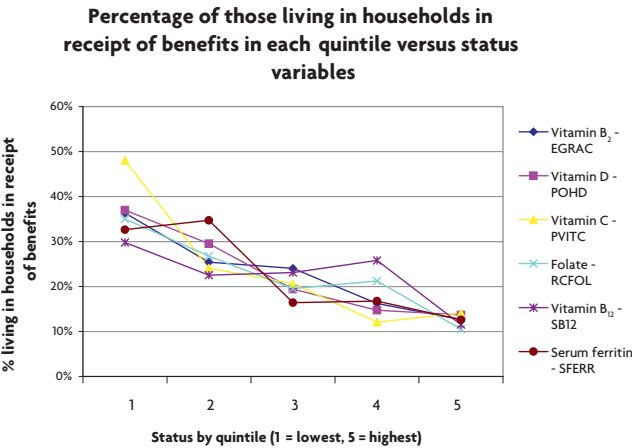
Status variables are shown only where significant associations were found

Note: Analysis carried out on raw data (data not adjusted/standardised)

293. Figure D shows the relationship between nutrient status for vitamins B₁, B₂, B₆, B₁₂, folate, C and D and the percentage of smokers within each quintile for each status variable. The main statistically significant differences found were as follows:
294. For all these nutrients, the decrease in the percentage of smokers with increasing nutrient status was significant when quintile 1 was compared with quintile 5 ($p < 0.01$). This was also seen when quintile 1 was compared with quintile 2 for all nutrients except vitamin B₁ and vitamin D ($p < 0.05$ for vitamin B₆; rest $p < 0.01$), when quintile 1 was compared with quintile 3 for all nutrients except vitamin B₁₂ ($p < 0.05$ for vitamin B₆; rest $p < 0.01$), and when quintile 3 was compared with quintile 5 for vitamin B₂, B₆, B₁₂ and folate ($p < 0.01$).

295. The strongest relationship was between the percentage of smokers and status for folate, where the percentage of smokers decreased sequentially by quintile from quintile 1 to 5 (1 vs 2, 4 vs 5, $p<0.01$; 2 vs 3, 3 vs 4, $p<0.05$).

Figure E:

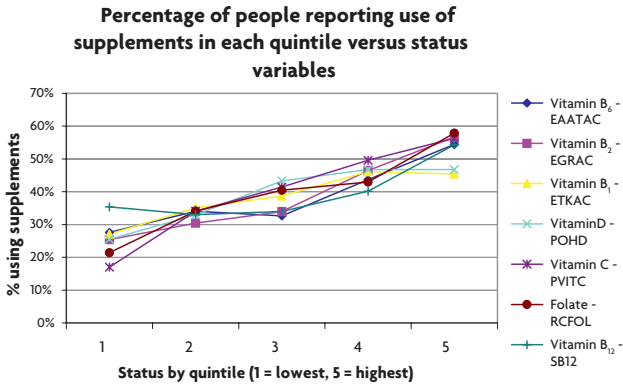


Status variables are shown only where significant associations were found

Note: Analysis carried out on raw data (data not adjusted/standardised)

296. Figure E shows the relationship between nutrient status for vitamin B₂, B₁₂, folate, C, D and iron, and whether respondents were living in households in receipt of benefits. The main statistically significant differences found were as follows:
297. For all these nutrients, the decrease in the proportion of adults living in households in receipt of benefits with increasing status was significant when quintile 1 was compared with quintile 5 ($p<0.01$). This was also seen when quintile 1 was compared with quintile 3 for all nutrients except vitamin B₁₂ and iron ($p<0.05$ for vitamin B₂; rest $p<0.01$), and when quintile 3 was compared with quintile 5 for all nutrients except vitamins C and D, and iron ($p<0.01$).

Figure F:



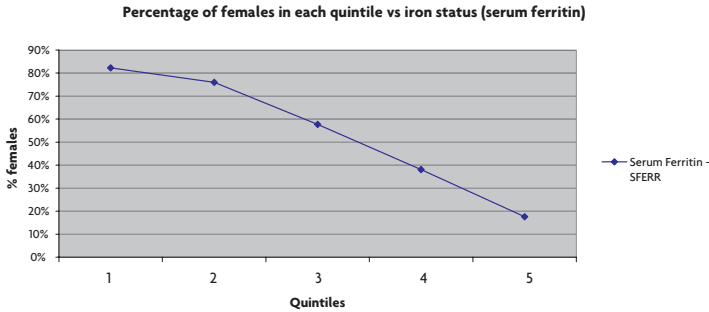
Status variables are shown only where significant associations were found

Note: Analysis carried out on raw data (data not adjusted/standardised)

298. Figure F shows the relationship between nutrient status for vitamins B₁, B₂, B₆, B₁₂, folate, C and D, and whether respondents reported use of supplements, and shows an increase in the general use of supplementsⁱ with status for these particular nutrients. However, it should be noted that those with the highest nutrient intakes from food (i.e. excluding supplements) were the most likely to consume supplements. With this in mind, the main statistically significant differences found were as follows:
299. For all these nutrients, the increase in reported supplement use with increasing nutrient status was significant when quintile 1 was compared with quintile 5 ($p < 0.01$). This was also seen when quintile 1 was compared with quintile 3 for all nutrients except vitamin B₆ and vitamin B₁₂ ($p < 0.05$ for vitamin B₂; rest $p < 0.01$), and when quintile 3 was compared with quintile 5 for all nutrients except vitamin B₁ and vitamin D ($p < 0.01$).
300. For vitamin C, reported use of supplements increased sequentially by quintile, from quintile 1 through to quintile 4 (1 vs 2, $p < 0.01$; 2 vs 3 and 3 vs 4, $p < 0.05$).

ⁱ Includes supplements containing micronutrients, other types of dietary supplements and herbal preparations

Figure G:



Note: Analysis carried out on raw data (data not adjusted/standardised)

301. Figure G shows the percentage of females in each quintile by iron status. The proportion of females in each quintile decreased sequentially from quintile 1 through to quintile 5 (1 vs 2, $p<0.05$; rest $p<0.01$).

Dietary characteristics

302. Table 32 shows the dietary characteristics of adults with the lowest intakes of nutrients (i.e. quintile 1) compared with those with the highest intakes (quintile 5). These results show that those with the lowest nutrient intakes consumed significantly less of almost every food group. There was no difference in consumption of soft drinks (excluding fruit juice) by intake of any nutrient included in the analysis.
303. Differences in consumption levels of dietary supplements, nuts and seeds, savoury snacks, and sugars, preserves and confectionery were less marked. However, those with the lowest intakes of vitamin C consumed significantly more sugar, preserves and confectionery, and those with the lowest intakes of vitamin B₁₂ consumed significantly more savoury snacks.

Table 32: Quintile analysis: Significant differences in the consumption of food groups between those with lowest vs highest intakes for each nutrient ($p < 0.01$)

Food Group	Nutrient														
	K	Ca	Mg	Fe	Cu	Zn	I	Reti- nol	Vit D	Thia- min	Riboflavin	Vit C	Vit B6	Vit B12	Folate
Compared to those with the highest intakes (quintile 5) those with the lowest intakes (quintile 1) consumed significantly less:															
Cereals and cereal products	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
• Bread	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
• Breakfast cereals	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Milk and Milk products	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
• Milk (liquid whole, semi-skimmed and skimmed)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
• Cheese	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Eggs and Egg dishes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fat spreads	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Meat and meat products	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
• Liver and liver products	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓
Fish and fish dishes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
• Oily fish	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓
Fruit and Vegetables (including potatoes and fruit juice)	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
• Vegetables (excluding potatoes)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
• Potatoes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 32 (continued): Quintile analysis: Significant differences in the consumption of food groups between those with lowest vs highest intakes for each nutrient ($p < 0.01$)

Food Group		Nutrient														
		K	Ca	Mg	Fe	Cu	Zn	I	Reti- nol	Vit D	Thia- min	Riboflavin	Vit C	Vit B6	Vit B12	Folate
• Fruit (including fruit juice)	• Fruit (excluding fruit juice)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	• Fruit (excluding fruit juice)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	• Fruit juice	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sugar, preserves and confectionery		✓	✓	✓		✓	✓	✓			✓					
Savoury snacks		✓											✓			
Alcoholic beverages		✓	✓	✓	✓	✓	✓	✓	✓		✓			✓		✓
• Beer and Lager		✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓
Tea, coffee and water		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
Dietary supplements ^a					✓											
Nuts and seeds		✓		✓	✓	✓	✓					✓				✓
Soft drinks (excluding fruit juice)																
Compared to those with the highest intakes (quintile 5) those with the lowest intakes (quintile 1) consumed significantly more:																
Sugar, preserves and confectionery													✓			
Savoury snacks															✓	

^θ The 'dietary supplements' food group relates to the number of dietary supplements consumed during the survey week only (e.g. number of tablets, capsules etc)
 Note: Analysis carried out on raw data (data not adjusted/standardised)

304. Table 33 shows the dietary characteristics of adults with the lowest nutritional status (i.e. quintile 1) compared with those with the highest nutritional status (quintile 5). Data in the shaded boxes highlight the main findings therein which were examined further and are presented in figures H-M. That is, those food groups associated with low status for a number of nutrients included in the analysis (i.e. five and above), and where similar results had been found for the previous analysis undertaken as described in paragraph 244. In addition, there appeared to be a relationship between the consumption of milk, soft drinks (excluding fruit juice) and vitamin B₂ status, which warranted further investigation. Presentation of the other significant relationships between consumption of food groups and nutritional status is limited to Table 33.
305. When considered together, the consumption of fish and fish dishes, and fruit and vegetables (particularly fruit) had clear associations with the status for all nutrients included in the analysis. Those with the lowest status for these nutrients consumed less of these foods compared to those with the highest status. In addition, those with the lowest status for iron, folate, vitamin B₁₂ and vitamin B₂ consumed more savoury snacks, and those with lowest status for folate, vitamin B₁ and vitamin B₆ consumed more sugar, preserves and confectionery. Finally, those with the lowest status for vitamin B₂ consumed more soft drinks (excluding fruit juice), and less milk, compared to those with the highest status. These key findings were examined further and presented in the following graphs (figures H-M).

Table 33: Quintile analysis: Significant differences in the consumption of food groups between those with the lowest vs highest status for each nutrient. ($p < 0.01$) Shaded data: key findings investigated further

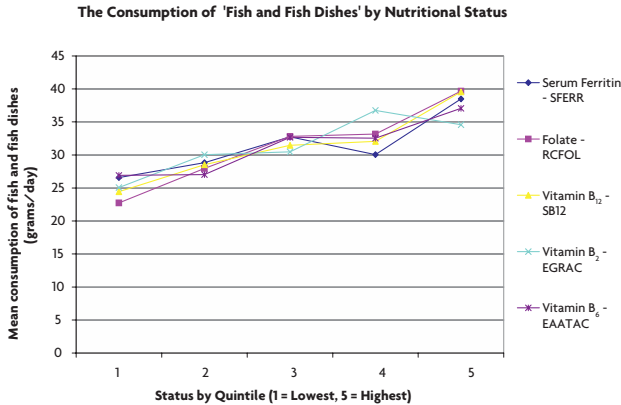
Food Group	Status							
	Iron	Vitamin D	Folate	Vitamin B12	Vitamin C	Vitamin B1	Vitamin B2	Vitamin B6
<i>Compared to those with the highest status (quintile 5) those with the lowest status (quintile 1) consumed significantly less:</i>								
Cereals and cereal products			✓	✓			✓	
• Bread	✓							
• Breakfast cereals			✓	✓	✓		✓	
Milk and Milk products			✓	✓		✓	✓	
• Milk (liquid whole, semi-skimmed and skimmed)				✓			✓	
• Cheese								
Eggs and Egg dishes	✓							
Fat spreads								
Meat and meat products	✓			✓				
• Liver and liver products	✓							
Fish and fish dishes	✓		✓	✓			✓	✓
• Oily fish			✓					
Fruit and Vegetables (including potatoes and fruit juice)		✓	✓		✓	✓	✓	
• Vegetables (excluding potatoes)			✓		✓			
• Potatoes	✓							
• Fruit (inc fruit juice)			✓	✓	✓	✓	✓	✓

Table 33 (continued): Quintile analysis: Significant differences in the consumption of food groups between those with the lowest vs highest status for each nutrient. (p<0.01) Shaded data: key findings investigated further

Food Group	Status							
	Iron	Vitamin D	Folate	Vitamin B12	Vitamin C	Vitamin B1	Vitamin B2	Vitamin B6
• Fruit (exc fruit juice)		✓	✓	✓	✓	✓	✓	
• Fruit juice			✓		✓			✓
Sugar, preserves and confectionery								
Savoury snacks								
Alcoholic beverages	✓							✓
• Beer and Lager	✓							✓
Tea, coffee and water			✓	✓			✓	
Dietary supplements		✓	✓				✓	
Nuts and seeds								
Soft drinks (excluding fruit juice)								
<i>Compared to those with the highest status (quintile 5) those with the lowest status (quintile 1) consumed significantly more:</i>								
Cereals and cereal products								✓
• Bread					✓			✓
Fat spreads				✓				
Meat and meat products					✓			
• Potatoes				✓				
Sugar preserves and confectionery			✓			✓		✓
Savoury snacks	✓		✓	✓			✓	
• Beer and Lager					✓			

o The 'dietary supplements' food group relates to the number of dietary supplements consumed during the survey week only (eg. number of tablets, capsules etc)
 Note: Analysis carried out on raw data (data not adjusted/standardised)

Figure H:

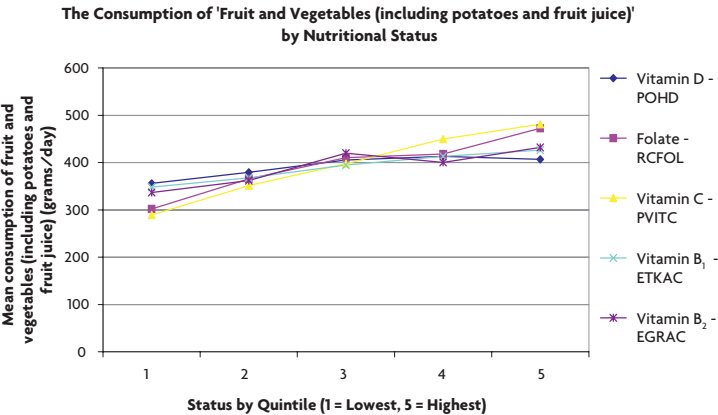


Status variables are shown only where significant associations were found

Note: Analysis carried out on raw data (data not adjusted/standardised)

306. Figure H shows the trend in higher consumption of fish and fish dishes with increasing status for iron, folate, vitamin B₂, B₆ and B₁₂. The main statistically significant differences found were as follows:
307. The increase in the amount of fish consumed with status for all these nutrients was significant when quintile 1 was compared with quintile 5 ($p < 0.01$), and, for iron and folate, when quintile 1 was compared with quintile 3 (folate $p < 0.01$, iron $p < 0.05$). For vitamin B₁₂, there was a significant increase in fish consumption between quintiles 1 and 3, and quintiles 3 and 5 ($p < 0.05$).

Figure I:



Status variables are shown only where significant associations were found

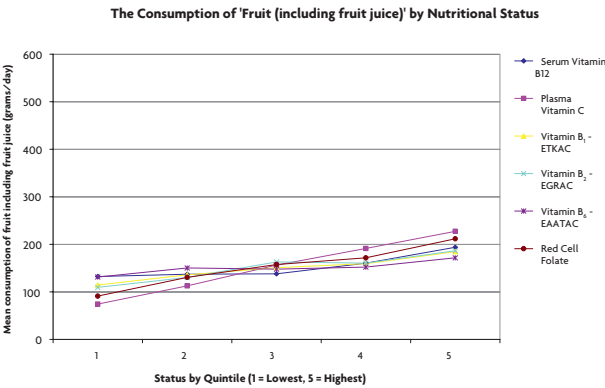
Note: Analysis carried out on raw data (data not adjusted/standardised)

308. Figure I shows the trend in higher consumption of fruit and vegetables (including potatoes and fruit juice) with increasing status for vitamin B₁, B₂, C, D and folate. The main statistically significant differences found were as follows:

- The increase in total fruit and vegetable consumption with status for all these nutrients was significant when quintile 1 was compared with quintile 5 ($p < 0.01$) and when quintile 1 was compared to quintile 3 ($p < 0.01$ for folate, vitamin B₂ and C, $p < 0.05$ for vitamin B₁ and D).
- The strongest relationships were between total fruit and vegetable consumption and status for vitamin C and folate. For vitamin C, total fruit and vegetable consumption increased sequentially by quintile from quintile 1 to 4 (2 vs 3: $p < 0.05$, rest: $p < 0.01$). For folate, consumption increased sequentially from quintile 1 to quintile 3, and from quintile 4 to 5 (2 vs 3: $p < 0.05$, rest: $p < 0.01$).

309. Table 32 showed that within this food group, fruit was a main contributor to nutrient status overall. The consumption of fruit (including fruit juice) by nutritional status is presented in figure J.

Figure J:



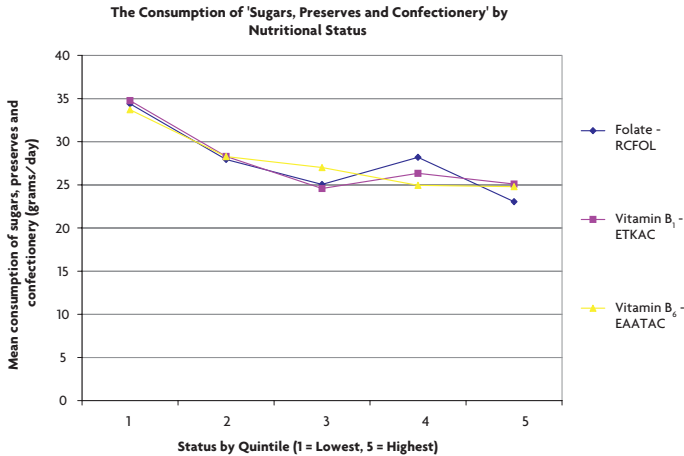
Status variables are shown only where significant associations were found

Note: Analysis carried out on raw data (data not adjusted/standardised)

310. Figure J shows the trend in higher consumption of fruit (including fruit juice) with increasing status for vitamin B₁, B₂, B₆, B₁₂, C and folate. The main statistically significant differences found were as follows:

311. The increase in fruit consumption with status for all these nutrients was significant when quintile 1 was compared with quintile 5 ($p < 0.01$). The strongest relationships were between fruit consumption and status for vitamin C and folate. For vitamin C, fruit consumption increased sequentially by quintile (3 vs 4 & 4 vs 5: $p < 0.05$, rest: $p < 0.01$). For folate, consumption increased sequentially from quintile 1 to quintile 3, and from quintile 4 to 5 (2 vs 3: $p < 0.05$, rest: $p < 0.01$).

Figure K:

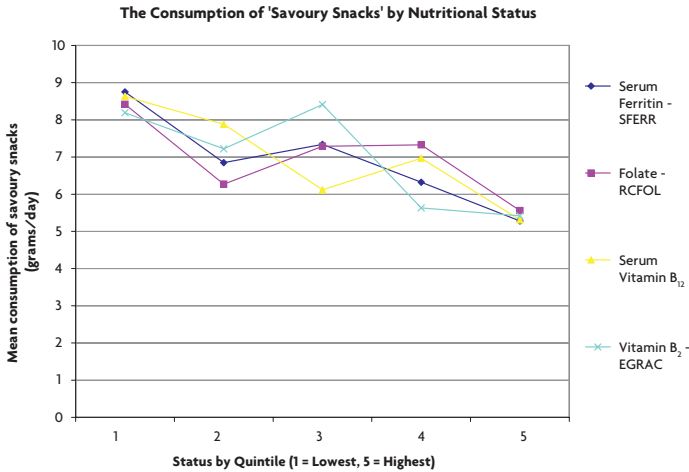


Status variables are shown only where significant associations were found

Note: Analysis carried out on raw data (data not adjusted/standardised)

312. Figure K shows the trend in lower consumption of sugar, preserves and confectionery with increasing status for vitamin B₁, B₆ and folate. The main statistically significant differences found were as follows:
313. The decrease in the consumption of sugar, preserves and confectionery with increasing status for these nutrients was significant when quintile 1 was compared with quintile 5 ($p < 0.01$). This was also seen when quintile 1 was compared to quintile 2 ($p < 0.05$), and quintile 3 (vitamin B₁ and folate $p < 0.01$, vitamin B₆ $p < 0.05$).

Figure L:

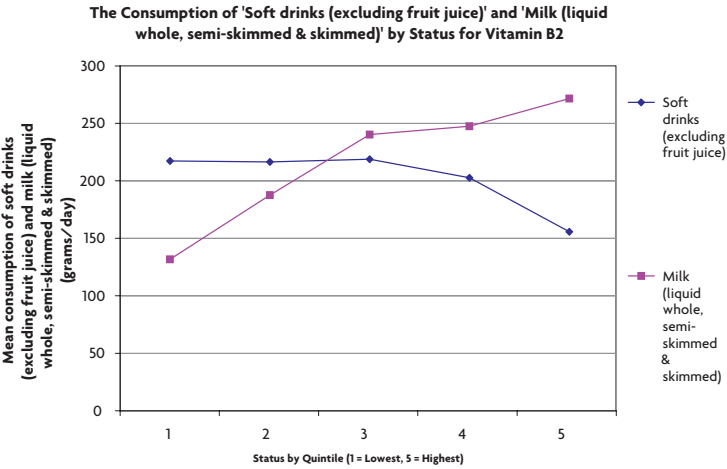


Status variables are shown only where significant associations were found

Note: Analysis carried out on raw data (data not adjusted/standardised)

314. Figure L shows the general trend in lower consumption of savoury snacks with increasing status for vitamin B₂, B₁₂, folate and iron. The main statistically significant differences found were as follows:
315. The decrease in the consumption of savoury snacks with increasing status for all these nutrients was significant when quintile 1 was compared with quintile 5 ($p < 0.01$), and when quintile 3 was compared to quintile 5 for vitamin B2 ($p < 0.01$), folate and iron ($p < 0.05$).

Figure M:



Status variables are shown only where significant associations were found

Note: Analysis carried out on raw data (data not adjusted/standardised)

316. Figure M shows the trends in consumption of soft drinks (excluding fruit juice) and milk (liquid whole, semi-skimmed and skimmed) by status for vitamin B₂.
317. These results show a significant increase in the consumption of milk, and a significant decrease in the consumption of soft drinks with status for vitamin B₂ when quintile 1 and quintile 5 are compared ($p < 0.01$).
318. For milk consumption, the increase in consumption is also significant sequentially from quintile 1 through to quintile 3 ($p < 0.01$). The decrease in soft drinks consumption with status is significant when quintile 3, and quintile 4 are compared to quintile 5 (quintile 3: $p < 0.01$, quintile 4: $p < 0.05$).

Discussion

319. These results of the quintile analysis support those produced by the original analyses presented earlier (see paragraphs 258-260).
320. Those with low intakes/status were more likely to be smokers, living in a household in receipt of benefits, and less likely to report taking supplements. These results also confirm that the younger adults were more likely to have low

intakes/status for some nutrients. This analysis by quintile has also provided further detail on the proportions of women with low iron status, to support data published in the original NDNS Adults report. The quintile analysis of iron intakes/status will be considered by the SACN Working Group on Iron as part of their consideration of the iron intake and status of the British population.

321. The results of this analysis by quintile show that those with the lowest intakes of these nutrients consumed a generally unbalanced diet²⁴ compared with those with the highest intakes. This is characterised by consumption of significantly less of almost every food group, with some evidence of increased consumption of sugar, preserves and confectionery, and savoury snacks. In addition, lower consumption of fish and fish dishes, and fruit and vegetables (particularly fruit), and a higher consumption of sugar, preserves and confectionery, and savoury snacks, were the key indicators associated with lower nutrient status. This analysis also corroborates the earlier observation that soft drinks (excluding fruit juice) may be replacing milk in the diet for those with lower status for vitamin B₂ (see paragraph 283). In addition, those with the lowest status for vitamin B₂, B₁₂, vitamin C and folate consumed less breakfast cereals (many of which are fortified with vitamins B₂, B₁₂ and folate), and breakfast cereals are usually consumed with milk (a major source of vitamin B₂ in the diet).

Principal components analysis (PCA)

Method

322. Foods are not consumed in isolation. The aim of this analysis was to obtain a summary of the different patterns of food consumption due to the large range of foods consumed in many diets. The multivariate technique, Principal Components Analysis (PCA), is one way to characterise food consumption patterns rather than individual foods. The variation within the population's consumption of food types (only) was summarised into independent components. These 'new' variables (Principal Components) aim to explain most of the variation of the original variables.
323. The detailed methodology used to undertake this analysis is provided in Annex 4.

Results

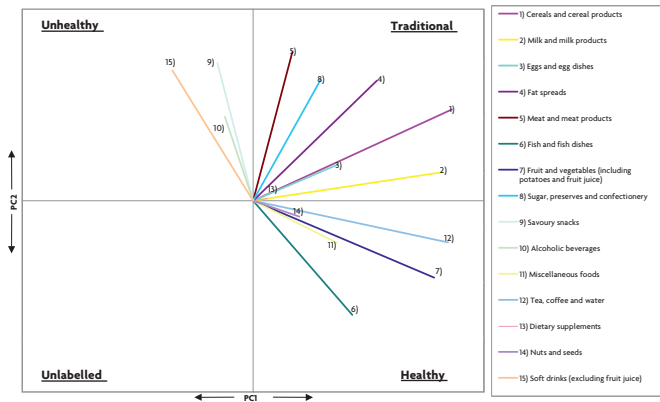
324. A summary of the key results from this analysis are presented here. For more detailed results see Annex 5.

325. The components identified explained approximately a quarter of the variation in food consumption when the level of aggregation was set at 15 food groupings and the results were collapsed down to 2 dimensions. From a plot of components one and two (see figure N) it appeared that certain food types were clustering together in different quadrants of the plot. Table 34 summarises the dietary patterns of these quadrants and the non-dietary characteristics of the individuals who were found in each quadrant (see also figure 1, Annex 5). The four quadrants were named: 'unlabelled', 'unhealthy', 'traditional' and 'healthy'.

Table 34: Summary of the dietary and non-dietary characteristics associated with the four quadrants identified using PCA

Quadrant	Trends
'Unlabelled'	No specific trends seen
'Unhealthy'	Highest consumption of soft drinks (exc fruit juice), savoury snacks and alcoholic beverages during the survey week across all quadrants More males than females in this quadrant Highest number of smokers across all quadrants Lowest number of supplement users across all quadrants Highest numbers who reported being unwell across all quadrants Highest number of respondents from benefit households across all quadrants Lowest mean intakes for all variables included across all quadrants Status variables: lowest in almost all, across all quadrants (i.e. except for iron)
'Traditional'	Highest consumption of meat and meat products; sugars, preserves and confectionery; fat spreads; cereals and cereal products; eggs and egg dishes; milk and milk products; dietary supplements during the survey week across all quadrants More males than females in this quadrant and the highest number of males across all quadrants Highest numbers in the 35-49 yr group in this quadrant Mean intake variables highest across all quadrants except for iron and vitamin D (similar to 'healthy'), thiamin, riboflavin, vitamin B₆ and C (highest in 'healthy') Status variables: similar to, or less than, 'healthy' except for iron. Highest iron status across all quadrants
'Healthy'	Highest consumption of tea, coffee and water; nuts and seeds; fruit and vegetables; fish and fish dishes; miscellaneous foods across all quadrants during the survey week More females than males in this quadrant and the highest number of females across all quadrants Highest numbers in the 50-64 yr group in this quadrant Highest numbers of vegetarians/vegans (although small sample size) across all quadrants Lowest number of smokers across all quadrants Highest number of supplement users across all quadrants Mean intake variables: Iron and vitamin D similar to 'traditional'. Highest intakes of thiamin, riboflavin, vitamin B₆ and vitamin C across all quadrants Status variables: Highest in almost all, across all quadrants (i.e. except for iron)

Figure N – Dietary characteristics associated with the four quadrants identified by Principal Components Analysis (PCA)



Discussion

326. The components identified through PCA only explained approximately a quarter of the variation in food consumption and therefore these results should be treated with some caution. However, this is of a comparable standard to existing published work in this area, both in the level of aggregation applied, and the quality of results produced.^{54,55} The PCA results also provide a similar picture to that provided by the previous analyses (when nutrient intake data were compared with current dietary recommendations (DRVs), nutritional status data were compared with standard cut-offs, and the quintile analysis).
327. The 'unhealthy' quadrant had the lowest mean nutrient intakes, and the lowest status for almost all variables included in this analysis. The dietary patterns associated with this quadrant included the higher consumption of soft drinks (excluding fruit juice) and savoury snacks. This quadrant also contained the highest number of smokers and those living in households in receipt of benefits, and the lowest number of those who reported using supplements.
328. Conversely, the 'healthy' quadrant had the highest intakes of some nutrients and the highest status levels for all variables except for iron. The dietary patterns associated with this quadrant included higher consumption of fish and fish dishes and fruit and vegetables. This quadrant also had the lowest number of smokers and the highest number of those who reported taking supplements.

329. For the 'traditional' quadrant, the numbers of smokers and supplement users were 'in between' those identified in the 'unhealthy' and 'healthy' quadrants. The dietary patterns for the 'traditional' quadrant included higher consumption of a range of general food groups, and had the highest mean intakes for the majority of nutrients included in the analysis. Results for status variables were similar to, or less than, the 'healthy' quadrant, except for iron where higher status was associated with the 'traditional' quadrant.
330. The 'Unlabelled' quadrant is unlabelled as none of the food groups are represented in this quadrant. As the naming convention is based on the types of food groups found in each quadrant, no specific name has been applied. While naming the quadrant is difficult, we do know that the foods found in the 'unlabelled' quadrant are consumed in far less quantity compared with the 'traditional' quadrant due to its diametrically opposed position. This could be people consuming less, or might be because of under-reporting. Due to the ambiguity found in this quadrant it is harder to draw any sort of clear conclusions and so analysis of this information should concentrate on the other three quadrants.

Conclusions

331. When nutrient intake data were compared with current dietary recommendations (DRVs) and nutritional status data were compared with standard cut-offs, the results showed that, at a population level, adults with low intakes of micronutrients consumed a generally unbalanced diet²⁴. In particular, low micronutrient status was associated with lower consumption of fish and fish dishes, fruit and vegetables and dietary supplements, and a higher consumption of savoury snacks and soft drinks (excluding fruit juice), which could displace other foods rich in micronutrients. Key non-dietary characteristics associated with low nutrient intake/status were smoking, living in households in receipt of benefits and less reported supplement use. Low nutrient intakes/status were also more likely to be found in younger age groups.
332. Similar patterns were seen when the data were considered using quintile analysis and PCA. Results of the quintile analysis showed that in addition to the above findings, higher consumption of sugar, preserves and confectionery was associated with low nutrient intake/status. However, the association between low nutrient intake/status and higher consumption of soft drinks (excluding fruit juice) was not seen. Results of the PCA showed that the quadrants defined

as 'healthy' and 'unhealthy' concurred with the results outlined above. The dietary patterns associated with the 'healthy' quadrant (which had the highest intakes of some nutrients listed in table 26 and the highest status levels for all nutrients listed in table 27 except iron) included higher consumption of fish and fish dishes, and fruit and vegetables. The dietary patterns associated with the 'unhealthy' quadrant (which had the lowest mean intakes and lowest status for almost all nutrients), were higher consumption of soft drinks (excluding fruit juice) and savoury snacks. The 'healthy' quadrant had the lowest number of smokers and highest number of those taking supplements. The opposite was seen for the 'unhealthy' quadrant.

333. The results of these secondary analyses suggest that to improve the micronutrient intake/status of this population group continued promotion of the balance of foods required to maintain a healthy diet, along the lines of those provided in the Eatwell Plate²⁴ is important. This would include recommendations for the consumption of fruit and vegetables and for fish, and recommendations to limit the consumption of foods high in fat and sugar such as savoury snacks, sugars, preserves and confectionery, and soft drinks. These results suggest that these foods, many of which are high in fat and sugar, could be displacing other foods rich in micronutrients from the diets of those with low micronutrient intakes and/or status. For example, consideration could be given to promote the replacement of some soft drinks in the diet with low fat milks.
334. It is important to note that those adults taking supplements tended to be those with higher intakes of these micronutrients from food.
335. The results of these analyses give strength to the need for promotion of dietary messages within the context of healthy lifestyle, with particular emphasis on not smoking and increasing levels of physical activity. The results also indicate that the particular groups who would benefit most from acting upon these messages include young adults, smokers and those living in benefit households. Results from the Low Income Diet and Nutrition Survey²² published in 2007, provide detailed information of the diet and nutrition of those materially deprived to help target this vulnerable population group.

Section II Recommendation

336. It is therefore recommended that a healthy balanced diet approach is appropriate for addressing low micronutrient intakes and/or status in this population sub-group, along the lines of those provided in the Eatwell Plate²⁴. This data shows that those with the lowest intakes of these nutrients consumed less food overall compared with those with higher intakes, resulting in significantly lower intakes of energy. They also consumed a generally unbalanced diet¹. This indicates a need to address balancing the diet as a whole to ensure adequate intakes of a range of nutrients rather than focussing on use of dietary supplements. This healthy balanced diet approach should be targeted at young adults, smokers and those from lower socio-economic groups. This would be integrated into current healthy lifestyle messages (e.g. not smoking, maintaining appropriate body weight and increasing levels of physical activity) and would, if successful, bring about improvements in the well being of this population.

¹ A balanced diet includes consuming plenty of fruit and vegetables, foods rich in starch and fibre such as bread, cereals and potatoes; consuming moderate amounts of meat, fish, eggs, nuts, beans pulses, milk and dairy products (choosing reduced fat versions where possible); consuming food and drink high in saturated fat and sugar occasionally and if alcohol is consumed it is consumed sensibly (Eatwell Plate FSA, 2007).

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ANNEX 1

Government policies and initiatives on nutrition

UK

1. The Food Standards Agency's (FSA) *Strategic Plan 2005-10*¹ sets detailed objectives related to diet and nutrition in the UK to make it easier for consumers to choose a healthier diet.

England

2. *Choosing Health* (DH, 2004)² set out Government priorities and strategies to improve the diet and health of the English population. *Choosing a Better Diet: A food and health action plan* (DH, 2005)³ brings together all the commitments relating to food and nutrition in the White Paper, as well as further activity across Government to encourage healthier eating. It provides details on the action that needs to be taken at national, regional and local levels to improve people's health through improved diet and nutrition, directed by the following dietary objectives:
 - increase the average consumption of a variety of fruit and vegetables to at least five portions per day
 - increase the average intake of dietary fibre to 18 grams per day
 - reduce the average intake of salt to 6 grams per day
 - reduce the average intake of saturated fat to 11% of food energy
 - maintain the current trend in the average total intake of fat at 35% of food energy; and
 - reduce the average intake of added sugar to 11% of food energy
3. The Department of Health has since launched a £372 million cross-Government strategy, *Healthy Weight, Healthy Lives* in January 2008, setting out our ambition of enabling everyone in society to achieve and maintain a healthy weight (Department of Health, 2008)⁴
4. The Government has set out a Policy framework in *Healthy Weight, Healthy Lives* and *Choosing Health* focussed on reducing the prevalence of obesity, premature death from diseases such as cancer and coronary heart disease and the reduction of health inequalities. A key feature of the Government's strategy is action to promote healthier food choices and to reduce consumption of foods high in fat, sugar and salt and increase the consumption of fruit and vegetables.

Scotland

5. *The Scottish Diet Action Plan* (Scottish Office Department of Health, 1996)⁵ provides a framework of action to improve diet and make progress towards achieving dietary targets. The plan has been the central focus for diet and nutrition policy in Scotland since 1996 and was reviewed in 2006⁶. FSA Scotland's strategic targets were aligned with the objectives of *The Scottish Diet Action Plan and Eating for Health-Meeting the Challenge*⁷ (Scottish Executive, 2004). *Healthy Eating, Active Living Action Plan* was published in June 2008⁹ and outlines the Scottish Government's joint action on diet, physical activity and maintaining a healthy weight. The policy document links with a wider National Food Policy for Scotland that aims to promote a sustainable food and drink sector that also takes account of our national aims on the environment and public health. This addresses one of the key themes in the Scottish Diet Action Plan Review around improved cross policy working.

Wales

6. *Food and Wellbeing* (FSA Wales, 2003)¹⁰ is the nutrition strategy for Wales and was developed by FSA Wales, the Welsh Assembly Government and other key stakeholders. This focuses on measures to reduce food poverty and on the promotion of food equality with emphasis on the low income group, ethnic minority groups, infants, children, young adults and adults aged 65 years and over. Food and Fitness – Promoting Healthy Eating and Physical Activity for Children and Young People in Wales: 5 Year Implementation Plan was launched by the Welsh Assembly Government in June 2006¹¹. The plan sets out some of the ways in which the Assembly Government is helping to support parents and children and young people in their efforts to eat well, stay fit and achieve the highest standard of health possible. Following the National Welsh Food Debate in Autumn 2007 a Quality Food For All in Wales Action Plan is under development, which will supersede Food and Well Being. The remit for the strategy is broad and cross cutting and it will look to integrate policies from key areas across the Assembly Government such as agriculture, education, social justice, health etc and will link the healthy eating and sustainable development agendas.

Northern Ireland

7. Nutrition is a priority area in the Northern Ireland Executive Public Health Programme *Investing for Health* (2002)¹². The Childhood Obesity Task Force Report, *Fit Futures*¹³ was published in March (2006) and provides policy context for much of FSA Northern Ireland's current commitments. The Response from the Ministerial Group on Public Health including consultation on the Fit

Futures Implementation Plan was published in January 2007 and highlighted over 70 key tasks to take forward. An Obesity Prevention Steering Group was established in February 2008 to update and address all these key tasks using the expertise of subject specific Advisory Groups including one on Food & Nutrition.

8. Work is continuing with the Department of Education (DE), Health Promotion Agency (HPA) and the Food Standards Agency Northern Ireland (FSANI) to develop the policy document on Food in Schools, food-based nutritional standards (for School Meals and Catering for Healthier Lifestyles) and a Food in Schools Toolkit.

Main Government initiatives

Fruit and Vegetables

9. The 5 A DAY programme¹⁴ aims to encourage the population of England to increase fruit and vegetable consumption (DH, 2002) and is supported by *The School Fruit and Vegetable Scheme*¹⁵. All four to six year old children in Local Education Authority (LEA)-maintained infant, primary and special schools in England are entitled to a free piece of fruit or vegetable on each school-day (DH, 2004). Similar schemes have been established in Scotland and Northern Ireland. In Wales the Welsh Assembly Government's Primary School Free Breakfast Initiative includes a portion of fruit or fruit juice as part of the breakfast.

Salt

10. Since the FSA's adoption of SACN's recommendations to reduce average daily salt intakes to 6g, published in its *Salt and Health* report in 2003¹⁶, it has been working to achieve this objective. This has been through two main routes – working with all sectors of the food industry to reduce levels of salt in food, as around 75% of the salt we eat is already in everyday food, and supporting this with three phases of a public awareness campaign. As part of the work to reduce levels of salt in food, in March 2006 the FSA published targets for 85 different product categories, providing guidance to the food industry on the types of food in which reductions should be made and the level of reductions needed¹⁷.
11. Early in 2008 the FSA started a review of the targets to consider what further reductions are necessary to maintain progress towards achieving the 6g intake target. The revised targets were published for consultation in July 2008¹⁸, with the aim of publishing the final targets by the end of the year. The three phases

of the campaign have been run in 2004, 2005 and 2007, with the aim of making consumers aware of why high salt intakes are bad for health and what they can do to reduce their intakes. Evaluation of the campaign shows that the number of people claiming to look at labels for salt and trying to cut back on their salt intake has increased by 50% and over 30% respectively and knowledge of the 6g a day message has increased 10 fold.

Saturated fat and energy

12. The FSA has developed a programme¹⁹ of initiatives to reduce intakes of saturated fat and to support wider Government initiatives on obesity.
13. The Programme covers two key elements. One, to raise consumer awareness of saturated fat in the diet through a media campaign planned for launch in early 2009. The second element includes working in partnership with industry stakeholders to explore the opportunities to reduce the levels of saturated fat and added sugar in the key contributing foods that they produce and sell, to reduce portion size where appropriate, and to increase the availability of healthier options.

Vitamins and Minerals

14. *FSA Strategic Plan 2005-10*¹ set out aims to seek expert advice on the health implications of low vitamin and mineral (nutrient) intakes in some population groups, the results of which are detailed in this report.

Labelling

15. FSA is committed to help consumers make healthier choices by improving information and understanding and by encouraging them to take action themselves (*FSA Strategic Plan, 2005-10*¹). As part of this commitment the Agency has developed a voluntary front of pack nutrition labelling approach (the traffic light label) which has been designed to provide key nutritional information at a glance and supplements the nutrition information found on the back of product packaging. The traffic light label indicates whether a product is high (red), medium (amber) or low (green) in fat, saturated fat, sugars and salt and is intended to help shoppers easily identify healthier choices.
16. Following extensive consumer research and public consultation, the FSA Board made its recommendations on front of pack signposting in early 2006.²⁰ The Agency's approach has been adopted by a growing number of retailers,

manufacturers, service providers and restaurant/caterers²¹. It is also supported by a large number of public interest organisations²²

17. The FSA has commissioned an independent evaluation to assess the impact of the 3 main front of pack nutrition signpost labelling approaches used in the UK: monochrome schemes providing information on percentage of Guideline Daily Amount (GDA); traffic light colour coded schemes indicating nutrient level; and schemes which provide both a traffic light colour code and percentage of GDA, on consumer behaviour and understanding. The project will assess how effective these different labels are in terms of helping shoppers make healthier purchasing decisions and which elements of the different schemes best help people to correctly interpret nutritional information on food. The project is expected to report at the end of 2008.

Work with the Catering and Foodservice Sector

18. In recognition of the significant and increasing contribution of foods eaten out of home to the diet, the FSA has sought to secure a greater contribution from business in the catering sector to its work to reduce average population intakes of salt and saturated fat, and to help consumers maintain energy balance.
19. In January 2008, FSA published the first round of this work²³, with voluntary public commitments from the five largest providers of workplace catering (who between them account for around 85% of the sector) together with the two largest wholesale suppliers to the catering sector at large. These commitments set out a range of detailed action, covering procurement, menu planning, kitchen practice and consumer information.
20. The FSA is now extending this approach to the major companies in a series of prioritised sub-sectors of the industry, including quick service restaurants, pub dining, casual dining and coffee & sandwich shops. More information on this work will be available on the FSA website as it develops.
21. The Healthy living Award, a national award in Scotland launched by the Scottish Government and the Scottish Consumer Council in September 2006, gives recognition to caterers and the foodservice sector for taking a range of steps to provide healthier options to their customers.

Retailers

22. The Scottish Grocers' Federation Healthy living Programme was established in 2004 through a partnership between the Scottish Government and the convenience store retail trade. The programme is improving the supply and provision of healthier food choices, focusing on fresh produce, in local neighbourhood shops, particularly in low income areas.

Food Promotion

23. The Office of Communications (Ofcom) introduced rules to restrict TV advertising of foods high in fat, salt or sugar (NFSS) during children's viewing times (Ofcom, 2006)²⁴. The Food Standards Agency developed a Nutrient Profiling (NP) model specifically for this purpose, to be used by Ofcom as a tool to differentiate foods on the basis of their nutritional composition and to permit the continued advertising of non-HFSS products.
24. The Committee of Advertising Practice (CAP) has introduced similar rules for the content of non-broadcast advertising.

Local Community Initiatives

25. The FSA supports local initiatives through a programme of grants to local authorities for food hygiene and healthy eating projects. The scheme is open to local authorities in all UK countries, and for work in 2008/09 particularly welcomed proposals for working with older people, projects using the Agency's Food Competency Framework for Children and Young People and for work that continued or extended existing initiatives into new areas or new target audiences.
26. The FSA, with its partners LACORS and the Local Government Association, support the Food Vision website (<http://www.foodvision.gov.uk/>). This website acts as an information portal for local authorities as well as community members who want more information about health and wellbeing within their own area. The case studies and toolkits within the site are designed to illustrate good practice and inspire those who would like to set up new initiatives.
27. To acknowledge the important role that local authorities play in their local community and to recognise the good practice they have demonstrated the FSA has introduced the Food Champion award. In the first round of awards, announced in April 2008, six local authorities were awarded Food Champion

status for improving community diet and nutrition and five for their food safety and standards work. Winners will be working with the Agency and other organisations in the coming year to champion their approach, and learning to encourage and share good practice. All local authorities in England and Wales were eligible to take part in the award scheme.

28. The Welsh Assembly Government supports local community initiatives across Wales. This includes the Community Food Co-operative programme launched in 2004. The key focus is to supply, from locally produced sources as far as possible, quality affordable fruit and vegetables to disadvantaged communities through the development of sustainable local food distribution networks. 180 food co-operatives have been established under this scheme as of June 2008.
29. Food Standards Agency Wales set up the *Annual Awards for Food Action Locally* (AFAL) scheme to recognise individual or team contributions to local nutrition initiatives, which have had a positive impact on the diet or eating habits of residents in the communities where they work (FSA Wales, 2003)²⁵. FSA Wales also published details of funding for initiatives on Nutrition and Diet as a resource for groups working on community projects and initiatives to improve diet and health and to reduce inequalities in Wales.
30. Community Food and Health Scotland, funded by Scottish Government, supports work within low-income communities to improve access to and take-up of a healthy diet.

Women and Children.

31. *Healthy Start*²⁶ is a statutory scheme replacing the Welfare Food Scheme, and was launched nationally in November 2006. The scheme offers participating women and children in low income families vouchers that they can exchange for milk, fresh fruit and vegetables or infant formula at participating retailers. It also offers free vitamin supplements for pregnant women and new mothers, and children. Advice and support for breastfeeding and healthy eating is available through health professionals. The scheme targets women and children in families getting qualifying tax credits or benefits. It is also available to any pregnant woman under 18 years old. Around half a million pregnant women and children across the UK are supported by Healthy Start.
32. *Sure Start*²⁷ is a government programme which has been set up in England to achieve better outcomes for children, parents and communities by increasing the availability of childcare for all children; improving health and emotional

development for young children and supporting parents in their aspirations towards employment. In Wales Cymorth provides a network of targeted support for children and young people, in order to improve life chances of young people from disadvantaged families, building on programmes such as Sure Start.

33. The FSA has recently published a new booklet giving advice to parents and carers on feeding and weaning their babies. 'Your baby: feeding your baby in the first year'²⁸, contains practical advice and takes parents through the various stages during a baby's first year, from feeding in the early months to starting on solid foods, and moving on to family meals.

Schools

34. The Department for Children, Schools and Families (formerly Department for Education and Skills - DfES) set minimum nutrition standards for school food in England in 2006 (DfES, 2006)²⁹. The standards apply to food served at lunchtimes and food other than lunch such as vending machines and tuck shops. Nutrient based standards are compulsory in primary schools from September 2008 and in secondary schools from September 2009. The School Food Trust (SFT)³⁰ is taking forward the implementation of these standards with schools and also aims to increase the uptake of schools meals. The nutrient based standards for school food are supported by the UK wide Target Nutrient Specifications (TNS) for manufactured foods (FSA, 2006)³¹. The National Healthy Schools programme³² is an initiative that helps young people and schools to develop a whole-school approach to physical and emotional well-being focused on four core themes - Personal, Social & Health Education; Healthy Eating; Physical Activity; and Emotional Health & well being.
35. Scotland is building on *Hungry for Success* through implementation of the Schools (Health Promotion and Nutrition) Scotland Act 2007³³. From August 2008, the Act places a legal duty on education authorities in Scotland to ensure that the food and drinks provided in schools complies with nutritional requirements, specified by regulations³⁴. The nutritional regulations go beyond the policy of *Hungry for Success* and include foods and drinks provided in other school food outlets. As part the drive to improve the nation's health and encourage healthier eating habits from a young age, the Scottish Government is also conducting a free school lunch trial for primary 1 to primary 3 pupils in five local authorities across Scotland.³⁵

36. In 2006 the Department of Education in Northern Ireland consulted on proposals for new, updated, nutritional standards for school lunches and other food outlets in schools (vending machines, tuck shops, etc). Updated standards came into effect from September 2007. Following discussions with the Education and Library Boards and other interested bodies the Department of Education made some minor amendments to the standards and an updated version of nutritional standards for school lunches was issued in March 2008³⁶. *Catering for Healthier Lifestyles, which detailed food based nutritional standards for schools in NI* will be updated in due course to take account of the new standards. The Food in Schools policy addressing a whole school approach to food is scheduled for public consultation in October to December 2008.
37. The Welsh Assembly Government launched the Welsh Network of *Healthy Schools Schemes* (1999), which has encouraged schools to consider action on food and nutrition, such as fruit tuck shops and breakfast clubs. The aim is for all LEA schools to be involved in the scheme by March 2010. In Wales, the Appetite for Life Action Plan sets out the strategic direction and actions required to improve the nutritional standards of food and drink provided in schools in Wales, including food and nutrient based standards for school lunches and other school food and drink, such as through vending, the free breakfast initiative and guidance on healthier lunchboxes. A two-year action research project involving four local authorities will run from September 2008 to develop, and test the guidelines for implementing the food and nutritional standards proposed in the action plan and learn lessons from this project to inform wider application across all maintained schools in Wales. Alongside this work, funding will also be made available via a specific grant scheme to support, across all authorities, those schools not involved in the action research project who wish to progress to the new standards.

Young Adults

38. NDNS highlights that many girls between the ages of 11 and 19 are missing out on nutrients they require to grow and develop as a result of not having a balanced diet. With this in mind, the Agency is working with the top selling teenage magazines, Bliss, Shout and Mizz to try to target and engage with this hard-to-reach audience. The advertorials feature messaging around the Agency's Food Competencies 4 themes: diet and health, consumer awareness, cooking, and food safety.

39. FSA Wales has launched *Get Cooking* (FSA Wales, 2005)³⁷, a toolkit for teaching basic cooking skills in a community setting to young people aged 14-25. FSA Wales has also published *Healthy Nosh for Less Dosh* (FSA Wales, 2005)³⁸ to provide healthy eating advice for those on a budget, especially suitable for students. Similarly, Scotland has published *First Time Self-Caterers*³⁹ as an aid to students and others in a new situation of having to cook for themselves (FSA Scotland, 2005).

Older Adults

40. A new FSA leaflet, 'The Good Life', which contains practical healthy eating advice to help the over-50s improve their diets, as part of a healthy lifestyle, has been published⁴⁰. FSA Wales are committed to providing support to older adults and have published *Eat Well- a guide to healthier for the over-60s and. Stock up your store cupboard*, which was published as part of *Keep well this winter* campaign (FSA Wales, 2005)^{41,42}.

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ANNEX 2

Notes to the tables

Lower Reference Nutrient Intake (LRNI)	The intake of a nutrient which is likely to meet the needs of 2.5% of the population.
Estimated Average Requirement (EAR)	The intake which is likely to meet the needs of 50% of the population
Reference Nutrient Intake (RNI)	The intake which is considered sufficient to meet the requirements of 97.5% of the population
NDNS food types	
Cereals & cereal products	Includes pasta, rice, pizza, bread, breakfast cereals, buns, cakes, pastries, puddings, other miscellaneous cereals
Milk & milk products	Includes milk, cream, cheese, yogurt, fromage frais, dairy desserts, ice cream, infant formula
Eggs & egg dishes	Includes eggs, quiches, soufflés, scotch eggs, meringue, pavlova, egg based composite dishes
Fat spreads	Includes butter and all types of spreading fats (fats used in cooking are reported according to the dish).
Meat & meat products	Includes all types of red meat, poultry, game, offal, meat pies, sausages, burgers and meat-based composite dishes
Fish & fish dishes	Includes all types of white and oily fish, shellfish, fish-based composite dishes and fish products
Vegetables & vegetable dishes	Includes all types of raw and cooked vegetables, vegetable-based composite dishes and vegetable products
Potatoes & savoury snacks	Includes chips and all types of potato, potato-based composite dishes, potato products, crisps and other savoury snacks (including cereal-based).
Fruit	All types – fresh, frozen, canned, dried. Not fruit juice
Nuts & seeds	All types including fruit and nut mixes, peanut butter
Sugar, preserves & confectionery	All types of chocolate and other confectionery, table sugar, jams and sweet sauces
Drinks	Fruit juice, soft drinks, tea, coffee, water, alcoholic drinks
Miscellaneous	Soups, savoury sauces, pickles, gravies, condiments, powdered beverages, commercial toddlers foods and drinks
Dietary supplements	All types including nutritionally complete supplement drinks

Data presented for all surveys except the 1986/87 adults survey and the NDNS children aged 1½-4½ years, have been weighted to compensate for the differential probabilities of selection and non-response.

Numbers of subjects shown in the tables are unweighted

n/d cut-off not defined

n/a data not available

'-' = no cases

'0' = less than 0.5

ANNEX 3

Glossary

Abbreviations

BMI	Body mass index
BMR	Basic metabolic rate
COMA	Committee on Medical Aspects of Food Policy
CVD	Cardio-vascular disease
DRV	Dietary Reference Value
EAATAC	Erythrocyte Aspartate Aminotransferase Activation Co-efficient
EAR	Estimated Average Requirement
EGRAC	Erythrocyte Glutathione Reductase Activation Co-efficient
ETKAC	Erythrocyte Transketolase Activation Co-efficient
HDL	High density lipoprotein
LDL	Low density lipoprotein
LIDNS	Low Income Diet and Nutrition Survey
LRNI	Lower reference nutrient intake
NDNS	National Diet and Nutrition Survey
NMES	Non-milk extrinsic sugars
NS	Not statistically significant
NSP	Non-starch polysaccharide
PAL	Physical activity level
RNI	Reference nutrient intake
RTD	Ready to drink
WHO	World Health Organisation

ANNEX 4

Principal Component Analysis: Methodology

1. The multivariate technique, Principal Component Analysis (PCA) is one way to characterise food consumption patterns rather than individual foods.
2. The basic idea of the method is to describe the variation of a set of multivariate data in terms of a set of uncorrelated variables, each of which is a particular linear combination of the original variables¹.
3. SPSS v12 was used to carry out the analysis. The various arithmetical procedures need not be described in detail because there are simple to use computer packages².
4. PCA was carried out on three forms of the original data. Firstly in the form it was collected in, the 111 food groups of the NDNS. It was then aggregated to the next level used in the NDNS, which comprises of 56 food groups. Finally it was aggregated into 15 'sensible' food groupings (see table 3).
5. How many of the components to extract is a common problem in PCA. There appears to be no hard and fast rule but a reasonable rule of thumb is to only retain those components that explain more the one p^{th} of the variation. If there are p variables then each variable will explain an average of $1/p$ of the variation. These important components will also have Eigenvalues greater than 1³. Therefore this "rule of thumb" is to be used in the analysis.
6. When displaying the results the food groups are ordered with the food group showing the strongest positive effect at the top of table with the strongest negative result at the bottom. Only values greater than ± 0.10 in the dietary patterns are shown. The reason for this is to present the results with clarity and brevity.

ANNEX 5

Principal Component Analysis: Detailed Results

1. The first PCA was carried out on the lowest level of food data in the NDNS and included 111 food groups (several were removed for having 1 or fewer entries, thus no variation). The analysis led to 45 components being extracted, which explained 58.6 % of variation. The first component accounted for 4.3% of the variation and the second component accounted for 2.7% of the variation. This result is not useful because the food groups were too diverse and there is not enough information held in the first two principal components to draw meaningful conclusions with PCA.
2. The food groups were then aggregated to the next level of NDNS food groupings. This included 56 food groups. 22 components were extracted explaining 55.8% of the variation. The first component accounted for 6.1% of the variation and the second component accounted for 4.1% of the variation. Again, there was not enough information held in the first two principal components to draw meaningful conclusions with PCA.
3. The next level of aggregation was based on food groups that are shown in Food Groups Table 3. Only food groups with no overlap were used, so this led to 15 food groups being included in the analysis. 6 components were extracted explaining 54.6% of the variation. The first component accounted for 12.4% of the variation and the second component accounted for 11.4% of the variation.

4. These Tables 1, 2 and 3 show food groups with factor loadings derived from the Principal Components Analysis. Only values greater than ± 0.10 in the dietary patterns are shown.

Table 1

Component 1		Component 2	
Variance explained (%)	12.43	Variance explained (%)	11.35
<i>More cereals and cereal products, tea, coffee and water, milk and milk products, fruit and vegetables (including potatoes and fruit juice)</i>		<i>More meat and meat products, savoury snacks</i>	
Cereals and cereal products	0.60	Meat and meat products	0.54
Tea, coffee and water	0.59	Savoury snacks	0.50
Milk and milk products	0.57	Soft drinks (excluding fruit juice)	0.48
Fruit and vegetables (including potatoes and fruit juice)	0.55	Sugar, preserves and confectionery	0.44
Fat spreads	0.38	Fat spreads	0.44
Fish and fish dishes	0.30	Cereals and cereal products	0.33
Eggs and egg dishes	0.26	Alcoholic beverages	0.31
Miscellaneous foods [*]	0.25	Eggs and egg dishes	0.13
Sugar preserves and confectionery	0.20	Milk and milk products	0.10
Nuts and seeds	0.14	Tea, coffee and water	-0.15
Meat and meat products	0.12	Miscellaneous foods [*]	-0.15
Savoury snacks	-0.11	Fruit and Vegetables (including potatoes and fruit juice)	-0.28
Soft drinks (excluding fruit juice)	-0.24	Fish and fish dishes	-0.42

^{*} = Includes soups, savoury sauces, pickles, gravies and condiments

Table 2

Component 3		Component 4	
Variance explained (%)	8.74	Variance explained (%)	7.86
<i>More alcoholic beverages</i>		<i>More soft drinks (excluding fruit juice)</i>	
Alcoholic beverages	0.53	Soft drinks (excluding fruit juice)	0.55
Fish and fish dishes	0.37	Savoury snacks	0.35
Eggs and egg dishes	0.36	Fruit and Vegetables (including potatoes and fruit juice)	0.32
Meat and meat products	0.34	Cereals and cereal products	0.30
Fruit and vegetables (including potatoes and fruit juice)	0.26	Nuts and seeds	0.29
Miscellaneous foods*	0.17	Miscellaneous foods*	0.25
Fat spreads	0.14	Fish and fish dishes	0.10
Soft drinks (excluding fruit juice)	0.13	Sugar, preserves and confectionery	-0.15
Savoury snacks	-0.16	Meat and meat products	-0.27
Tea, coffee and water	-0.31	Tea, coffee and water	-0.28
Milk and milk products	-0.36	Eggs and egg dishes	-0.34
Sugar, preserves and confectionery	-0.49	Alcoholic beverages	-0.34

* = Includes soups, savoury sauces, pickles, gravies and condiments

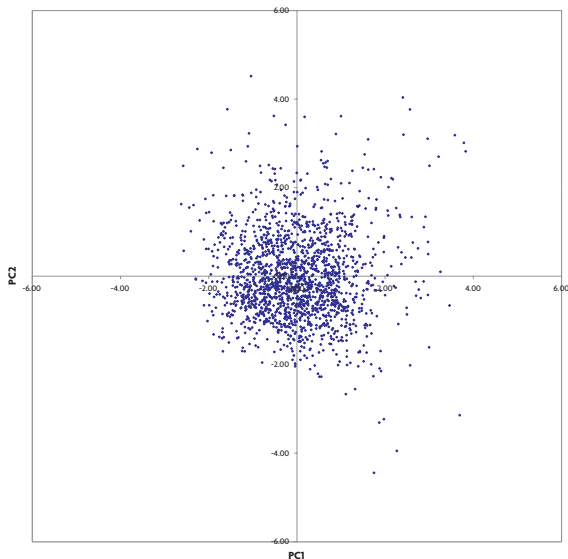
Table 3

Component 5		Component 6	
Variance explained (%)	7.27	Variance explained (%)	6.95
<i>More dietary supplements</i>		<i>More nuts and seeds, less miscellaneous foods*</i>	
Dietary supplements	0.72	Nuts and seeds	0.67
Milk and milk products	0.31	Eggs and egg dishes	0.36
Meat and meat products	0.23	Dietary supplements	0.35
Cereals and cereal products	0.20	Fat spreads	-0.13
Soft drinks (excluding fruit juice)	0.13	Miscellaneous foods*	-0.56
Fish and fish dishes	-0.10		
Tea, coffee and water	-0.15		
Fat spreads	-0.22		
Sugar, preserves and confectionery	-0.26		
Savoury snacks	-0.30		
Nuts and seeds	-0.33		

* = Includes soups, savoury sauces, pickles, gravies and condiments

5. This third level of aggregation is marginally useful. When collapsed down to 2 dimensions (i.e. focus on the first two principal components, which is standard practice in PCA) over three-quarters of the variation in the data is discounted (the first two components only cover 23.7% variation in the data).

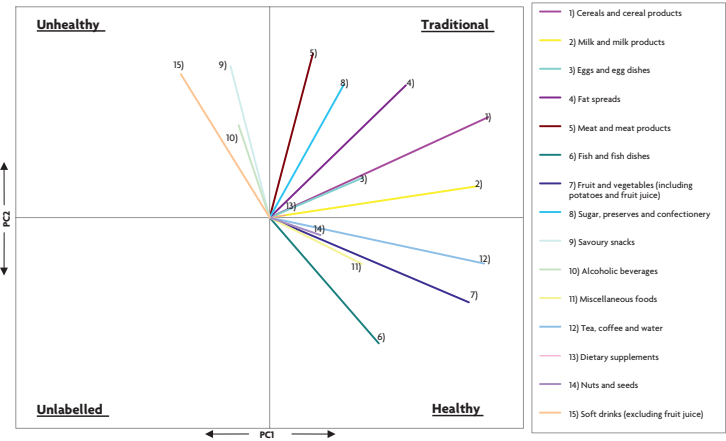
Figure 1:



6. The scatterplot of the individuals in relation to the first two principal components is usually a very important piece of output (see figure 1). In this case though, it is very difficult to pick out any pattern with individuals seeming to be more densely packed around the origin. (Examples of interpreting this sort of plot have a much smaller number of cases and therefore the problem here may be “not being able to see the wood for the trees”). Ideally we would like to see an elliptical pattern in the above scatterplot, but when contours of constant distance are nearly circular the sample variation is homogenous in all directions. It is not possible to represent the data well in fewer than p dimensions, where ‘ p ’ in this case equals the number of food groups⁴.

7. It is possible to plot the component weights of each principal component (food group) on a graph. The lines representing each specific food group are plotted from the origin (0, 0), with the end of the line being the (X, Y) co-ordinate representing the values (weight on first component, weight on second component). For example, variables plotted to the right of the origin have positive component weights for the first Principal Component. The longer these lines are the stronger the influence this variable has. This plot can therefore be used to identify those food groups that may be having a large influence on the position of any particular point or group of points. This is a similar technique to the 'Bi-Plot', a post analysis procedure some specialist packages use.

Figure 2:



8. From the above plot (figure 2) it seemed as if certain food groups were clustering in different quadrants of the plot. (NB: This is not a named style of analysis, just a way of interpreting the plot). In the top left corner we have: savoury snacks; alcoholic beverages; and soft drinks (excluding fruit juice). These could be labelled 'unhealthy'. In the top right corner we have: cereals and cereal products; milk and milk products; eggs and egg dishes; fat spreads; meat and meat products; sugar, preserves and confectionery; and dietary supplements. These could be labelled 'traditional' as most are found in a common/traditional diet. In the bottom right corner the food groups

fish and fish dishes; fruit and vegetables (including potatoes and fruit juice); miscellaneous foods; tea, coffee and water; nuts and seeds; are found. These could be considered as constituents of a 'healthy' diet. The bottom left hand corner had no lines from the Bi-Plot in it. It is therefore harder to describe the individuals in this quadrant. One way of looking at this group is to consider the points furthest away from it. For example, cereal and cereal products are probably the furthest point away from this quadrant which would suggest that the people in this quadrant do not eat much of this food group.

9. In summary, the key preliminary results of this analysis are as follows:
 - a) The components identified only explain about a quarter of the variation in the data when the level of aggregation was set at 15 food groupings and the results collapsed down to 2 dimensions
 - b) Notwithstanding the above, 4 quadrants have been identified, which have been labelled as:
 - c) 'Unlabelled'
 - d) 'Unhealthy'
 - e) 'Traditional'
 - f) 'Healthy'

The resulting display is merely an approximation to the true configuration⁵.

¹ Everitt B. S., Dunn G., Applied Multivariate Data Analysis Second Edition, Arnold 2001

² Ehrenburg A. S. C., Data Reduction, Analysing & Interpreting Statistical Data, John Wiley & Sons 1975

³ Ricketts C., Multivariate Statistics, 1999

⁴ Johnson R. A., Wichern D. W., Applied Multivariate Statistical Analysis 4th Edition, Prentice Hall 1998

⁵ Kraznowski W. J., Principles of Multivariate Analysis: a User's Perspective, Oxford University Press, 1988

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