Identifying dietary differences between Scotland and England: a rapid review of the literature

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Abstract

Objective: Rates of premature mortality have been higher in Scotland than in England since the 1970s. Given the known association of diet with chronic disease, the study objective was to identify and synthesise evidence on current and historical differences in food and nutrient intakes in Scotland and England.

Design: A rapid review of the peer-reviewed and grey literature was carried out. After an initial scoping search, Medline, CINAHL, Embase and Web of Science were searched. Relevant grey literature was also included. Inclusion criteria were: any date; measures of dietary intake; representative populations; cross-sectional or observational cohort studies; and English-language publications. Study quality was assessed using the Quality Assessment Tool for Observational Cohort and Cross-sectional Studies. A narrative synthesis of extracted information was conducted.

Results: Fifty publications and reports were included in the review. Results indicated that children and adults in Scotland had lower intakes of vegetables and vitamins compared with those living in England. Higher intakes of salt in Scotland were also identified. Data were limited by small Scottish samples, difficulty in finding England-level data, lack of statistical testing and adjustment for key confounders.

Conclusions: Further investigation of adequately powered and analysed surveys is required to examine more fully dietary differences between Scotland and England. This would provide greater insight into potential causes of excess mortality in Scotland compared with England and suitable policy recommendations to address these inequalities.

Keywords

Food consumption
Nutrient intake
Scotland
England
Mortality

Scotland is in the unenviable position of experiencing the highest age-standardised mortality rates and lowest life expectancy in Western Europe(1). Although health outcomes have improved in the last 20 years, with premature mortality in those under 75 years of age dropping by over one-third, the gap between the overall age-standardised death rates from all causes for Scotland and the UK as a whole(2) has not reduced. The gap remains at over 100 additional deaths per 100 000 individuals for Scotland, compared with the UK average.

Higher deprivation rates can explain some of these differences, but more than three-quarters of excess deaths cannot be accounted for through this explanation alone(3). Further support for examining alternative explanations comes from research that compared the largest Scottish city, Glasgow, with two English cities (Liverpool and Manchester) with similar rates of deprivation and life expectancy. The results from that work highlighted that Glasgow experienced 30% more premature deaths and 15% more total deaths than these two cities(4).

These large differences have received considerable critical attention in the literature, with a number of explanations put forward to explain the gap(5), such as historically high levels of deprivation, regional economic policies, de-industrialisation and low levels of social capital(6). The impact of diet and nutrition on health outcomes and life expectancy is of little doubt. Evidence identifies diet and obesity as key factors in CVD,
diabetes\(^7\) and some of the most common cancers\(^8\). Nevertheless, dietary differences in relation to Scotland and England, and more specifically Glasgow and similar English cities, have not been investigated adequately. It is estimated that if the Scottish diet were similar to that consumed in England, then potentially 40% of excess deaths could be avoided\(^9\). Comparing three years of food and nutrient data from the Family Food Survey, Scarborough et al.\(^9\) found that Scottish households were eating less fruit and vegetables, and more fat, saturated fat and salt, than English households.

**Policy context**

At a policy level, the need to tackle poor diet and obesity in Scotland has been recognised; however, progress in dietary change is slow\(^10\). In addition, large inequalities exist in the nutritional quality of diets\(^11\), contributing to the risk of chronic diseases and obesity, the rates of which are higher in areas of deprivation\(^12\). The Scottish Dietary Targets\(^13\), reconfigured as Dietary Goals\(^14\), aim to increase fruit, vegetable, whole grains and fish intakes, and reduce saturated fat and added sugar; however, dietary change remains elusive\(^10,11\). Given the evidence that deprivation alone does not explain the higher mortality rates observed for Scotland, a key concern for the Scottish Government is to understand what other factors influence the higher prevalence of chronic disease as an important contributor to lower life expectancy and greater burden on local health services. Examining the historical and current dietary differences between Scotland and England in the published literature provides an opportunity to identify key areas for action and further examination.

**Aim**

The present work was prepared in response to a commissioned call from NHS Health Scotland, a Scottish health board with a national remit to improve health and reduce inequalities. NHS Health Scotland commissioned a rapid review\(^15\) to identify and synthesise evidence on current and historical differences in food and nutrient intakes in Scotland and England (including differences between the cities of, and regions surrounding, Glasgow, Liverpool and Manchester). It is this work that the current paper reports.

**Methods**

**Study design**

Rapid review is an evidence synthesis methodology that applies a systematic approach to evidence identification and syntheses, but with a more limited scope than a systematic review. Rapid reviews generally seek a response to a policy or a clinically important query in a defined time period, working closely with the stakeholders seeking the answer to the query\(^16\). The need to draw together conclusions from the evidence in a timely manner impacts on the review’s precision\(^17,18\). Rapid reviews range in the methods used and the time period for completion, with some completed within 3 weeks and others taking as long as 6 months\(^18\). The present review was carried out over a 4-month period, and limited its scope by looking at four key databases, including English-language publications only, and by carrying out a restricted search of the grey literature.

**Search strategy**

An initial scoping search was carried out. This involved identifying key dietary surveys from across the UK via the authors’ expertise and online searches. Google Scholar was also searched using ‘Scotland’, ‘England’, ‘Diet’, ‘Glasgow’, ‘Manchester’ and ‘Liverpool’ as search terms. The keywords of identified studies were then used to create the search terms for the main study searches. Searches were run in four databases from database start dates (Medline, 1946; CINAHL, 1937; Embase, 1947; Web of Science, 1945) until October 2014, using search terms specific to each database (see online supplementary material, Supplemental Tables 1–4). The wide date range was essential for examining historical dietary differences. Search terms were built around the location of the study sample, diet and nutrition outcomes, and study design, specifically population-based observational studies. Medical Subject Heading (MeSH) terms were used for Medline, and Subject Headings for CINAHL and Embase. Inclusion and exclusion criteria were defined to enable publication selection (Table 1).

| Inclusion | Exclusion |
|-----------|-----------|
| All years | Non-English language publications |
| Cross-sectional and observational cohort studies (including longitudinal studies such as birth cohort studies) | Randomised controlled trials, quasi-experimental studies, case–control studies, qualitative studies |
| Representative populations from the whole of England, the whole of Scotland, or the cities and surrounding areas of Glasgow, Liverpool or Manchester (including any studies representative of any age (adults or children) or gender strata) | Samples not designed to be representative of the overall population (except age/gender strata including children) |
| Includes measures of food intake or purchasing including: | Conference abstracts |
| 1. Diet | |
| 2. Energy intake | |
| 3. Fruit and vegetable consumption | |
| 4. Fat and saturated fat intakes | |
| 5. Added sugar/NMES intakes | |
| 6. Vitamin and mineral intakes | |
| 7. Consumption of foods and drinks high in sugar | |
| 8. Consumption of foods high in fat | |
| 9. Consumption of foods high in salt | |

NMES, non-milk extrinsic sugars.
Grey literature searching included searches of key websites and liaison with National Health Service and Local Authority contacts in Glasgow, Liverpool and Manchester. Websites included the sites of UK (e.g. National Diet and Nutrition Survey, Low Income Diet and Nutrition Survey), English (e.g. Health Survey for England) and Scottish (e.g. Scottish Health Survey) national surveys; Glasgow, Manchester and Liverpool City Council websites; and Google (using the search terms 'Scotland', 'England', 'Diet', 'Glasgow', 'Manchester', 'Liverpool').

The reference lists of included grey literature and database papers were also hand-searched. To limit the scope of the work, only those references that could be retrieved within the 4-month study identification period were included.

Two researchers scanned titles and abstracts independently to identify publications requiring full-text review. The project lead acted as a third reviewer when there were disagreements. Inclusion was determined by a single reviewer examining the full text of publications with support from the project lead.

**Data extraction**

The Cochrane Collaboration data extraction form was adapted to make it more specific to the present review; for example, by removing items referring to experimental and quasi-experimental studies. Variables extracted included geographical area (e.g. country, region), study type (e.g. population-based observational study), survey name (e.g. Scottish Health Survey), study population (e.g. age, gender, socio-economic group), sample size, sampling method (e.g. random, convenience), survey administration (interviewer, mail, telephone, self-report), dietary assessment method (e.g. 24 h recall, weighed diary, FFQ), dietary outcome (e.g. fruit and vegetable intake, energy intake, vitamin intake), units of measurements (e.g. mg/d, portions/d), nutrient database used in the analysis, confounding variables (e.g. age, gender, socio-economic status, income, area deprivation) and dietary analysis software.

**Study quality**

The Quality Assessment Tool for Observational Cohort and Cross-sectional Studies, developed by the National Institutes of Health/National Heart, Lung, and Blood Institute, was used as a checklist for scoring study quality. The checklist assessed how representative the study population was, sample sizes, response rates, reliability and validity of measures, and adjustment for key confounders. An additional criterion was added as to whether the statistical analysis carried out in the study was suitable for answering the review questions. Studies were scored on a continuum of poor–fair–good quality dependent on individual scores for the criteria outlined above. Full information on study quality can be found in the online supplementary material, Supplemental Tables 5 and 6.

**Data synthesis**

Data were synthesised by dietary outcomes. Comparisons that tested for statistical significance were examined in greatest depth, covering foods consumed, macronutrients and micronutrients. Data that provided information on dietary trends, but did not test for statistical significance, were then examined. Where information was available for an English region only rather than England as a whole, the most relevant region for the study objectives was chosen for comparison. We chose to compare Scottish data with Northern England as this region is demographically the most similar to Scotland. The review was focused on publications with information for both Scotland and England; however, the study team compared national surveys carried out separately in England and Scotland where outcomes had been measured similarly and around the same time period (e.g. difference of 2 years or less).

**Results**

Figure 1 details a flow diagram of the search results. The database searches returned 4231 results. The scoping, Internet and reference list searches identified seventy-two results. After removal of duplicates, titles and abstracts were screened for 4281 results with full-text examination of 197 publications. The team excluded 147 publications due to non-representative samples or no suitable comparison for Scotland and England. From the grey literature, we identified reports from a number of national surveys. These included the Health Survey for England, the Scottish Health Survey, the National Diet and Nutrition Survey and predecessors, the National Food Survey/Expenditure and Food Survey/Living Costs and Food Survey, and the Low Income Diet and Nutrition Survey. A number of volumes from a single survey report were identified (e.g. Low Income Diet and Nutrition Survey; Scottish Health Survey). Multiple volumes for a survey in the same year were considered a single publication. Included publications provided data on a wide range of dietary outcomes (Tables 2 and 3). Three publications tested differences between Scotland and England as a whole statistically, as opposed to English regions or England and Wales. A single publication statistically tested data at the regional level, comparing Greater Glasgow and the North West of England, and Greater Glasgow and Greater Manchester.

Results are presented separately for dietary differences between Scotland and England in children and adults. Tables 2 (children) and 3 (adults) present an overview of the methodology used in each study. Table 3 details studies on adults and includes publications from the National Food Survey/Expenditure and Food Survey/Living Costs and Food Survey where food purchase data were collected at the household level and analysed to estimate per person intakes of foods and nutrients.
Information on child intake is included within the reports from the aforementioned surveys as part of the household sample; however, child-only results were not presented.

Results for those studies that carried out statistical tests of difference on data from Scotland and England are presented in Table 4 (children) and Table 5 (adults or households). Narrative results provide an overview of these studies, as well as referencing other studies that did not test for statistical difference, but support or contradict those studies that did.

**Children and young people**

Seven studies identified statistically significant differences in the diets of children living in Scotland and England. The main findings from these data were that dietary intake in Scotland appeared to be lower in nutritional quality than that in England or Northern England. Dietary differences were present as early as 1950, although not always negatively for Scotland. Prynne *et al.* found that 4-year-old children living in Scotland had lower intakes of vegetables and fruit; however, they also found positive differences, with higher intakes of porridge and soup, and lower intakes of cakes, biscuits, fried foods and bacon.

Energy intakes were lower in children living in Scotland in 1950, which perhaps explains why macro- and micronutrient intakes were also lower. Lower micronutrient intake was identified in Scotland for a number of vitamins and minerals in three additional studies. In contrast, in the 2007 Low Income Diet and Nutrition Study, boys living in low-income households in Scotland were less likely than those living in England to have intakes of Ca, K and Zn below the Low Nutrient Reference Intakes. No other studies provided data on significant differences in macronutrient intakes; however, intakes of fibre were lower for 16- and 17-year-olds living in Scotland in 1986. Differences in food consumption were identified and included children in Scotland being less likely to consume vegetables, fruit, spreading fat, skimmed milk, breakfast cereals and cakes. Children in Scotland were more likely to consume chips and soup. Consistent findings were identified only for soup, cake, vegetable and fruit consumption.

Similar results were reflected in studies that did not test for statistical differences in relation to lower fruit and vegetable intakes. In the Health Behaviour in School-aged Children surveys a higher percentage of
### Table 2 Overview of child studies

| Author and quality rating | Scotland | England | Response rate (%) | Dietary outcome | Data adjustment and statistical analysis |
|---------------------------|----------|---------|------------------|-----------------|----------------------------------------|
| **1946 British Birth Cohort (4-year-old children) (1950)** | Multistage cluster probability sample, 24 h recall diet records (mother/carer responding), data weighted | | | | |
| Prynne et al(58) | Good-fair | | | Dietary phylloquinone intake (μg/d, μg/MJ) | Energy intake, body weight |
| | n 527 | n 1119 | 86 | Dietary phylloquinone intake (μg/kg BW/d, % below 1 μg/kg BW/d) | (P values adjusted for sex and social class, but means presented unadjusted) ANOVA |
| Prynne et al(57) | Fair | | | Children consuming food once (%), energy intake (MJ/d), macronutrient intake (g/d), micronutrient intake (mg/d) | Social class, gender, season, food between meals, whether record contained weekday/weekend day |
| | n 527 | n 1119 | 86 | | Multiple logistic regression |
| **Diets of British School Children (aged 10/11 and 14/15 years) (1983)** | Multistage cluster probability sample, 7 d weighed diary (parent and child completed), data weighted; North England = Northern, North West and Yorkshire/Humberside | | | | |
| Committee on Medical Aspects of Food Policy 10/11 years: males, n 45; females, n 424 | Fair | | | Food and food groups (g/week), energy intake (kJ/d, fibre intake (g/d), macronutrient intake (g/d), micronutrient intake (mg/d or μg/d) | Data adjusted: limited to age group and gender |
| | 14/15 years: males, n 56; females, n 42 | | | | Statistical test not specified |
| **1970 British Cohort Study (aged 16/17 years old) (1986)** | Multistage cluster probability sample, 4 d weighed diary, data weighting unclear, significance testing | | | | |
| Crawley(59) | Males: n 85 | England/Wales | Unclear (only 34 % diaries usable) | Food and food groups (% respondents, g/d), energy intake (kcal/d, MJ/d), macronutrient intake (% energy/d), fibre (g/d), micronutrient intake (mg/d or μg/d) | Class, benefits receipt, housing, household size, no. of parents, education, mothers’ working status, microwave ownership, dieting, body size, smoking, takeaway consumption, eating out, feeding frequency, alcohol, television viewing, sports |
| | Females: n 133 | Males: n 573 | | | Unadjusted results presented Generised linear model |
| | | Females: n 824 | | | |
| **National Diet and Nutrition Survey (NDNS)** | Multistage cluster probability sample, 4 d weighed diaries in 1992/93 (mother/carer completed), data weighted; Scotland excluding islands; Northern England including North Yorkshire and Humberside and North West, Merseyside | | | | |
| Prynne et al(58) | Pooled data: 4-year-olds from NDNS 1992/93 & 1997 | Northern England | 81 | Dietary phylloquinone intake (μg/d, μg/MJ) | Energy intake, body weight |
| | | n 79 | Dietary phylloquinone intake (μg/kg BW/d, % below 1 μg/kg BW/d) | (P values adjusted for sex and social class, but means presented unadjusted) ANOVA |
| Gregory et al(37) | Fair | Northern England | 81 | Food and food groups (g/week, % consumers), energy intake (kJ/d, kcal/d, fibre intake (g/d), macronutrient intake (g/d, % energy), micronutrient intake (mg/d or μg/d) | Unadjusted results presented from bivariate analysis Statistical methods unclear |
| | | n 165 | Children meeting one or none of five dietary parameters (RNI for Fe, Zn, vitamin A, vitamin C, % energy from NMES) | | |
| Watt et al(60) | Fair | Northern England | 81 | % children meeting one or none of five dietary | Data not adjusted for Scotland/Northern England comparison ANOVA for region, but no comparison for Scotland/Northern England specifically |
| | | n 188 | parameters (RNI for Fe, Zn, vitamin A, vitamin C, % energy from NMES) | | |
| | | n 466 | | | |
| **4–18-year-olds (1997)** | Multistage cluster probability sample, 7 d weighed diary (mother/carer completed), weighted data | | | | |
| Gregory and Lowe(36) | Fair | Northern England | 64 | Food and food groups (g/week, % consumers), energy intake (kJ/d, fibre intake (g/d), macronutrient intake (g/d, % energy), micronutrient intake (mg/d or μg/d) | Confounding variables unclear Multiple regression; however, unadjusted results presented from bivariate analysis only |
| | Males: n 68 | | | | |
| | Females: n 69 | | | | |
| | Northen England | | | | |
| | Males: n 243 | | | | |
| | Females: n 217 | | | | |
| **Health Behaviour in School-aged Children (11, 13, 15 year olds)** | Stratified cluster probability sampling for some schools and classes, FFQ (not validated), data weighted | | | | |
| Currie et al(61) (2001/2) | Poor–fair | | | | Presented for age and gender Descriptive statistics |
| | Males: n 2246 | Fruit daily | Unknown | | |
| | Females: n 2158 | Vegetables daily | | | |
| | 11-year-olds: n 1743 | Soft drinks daily | | | |
| | Females: n 3138 | Sweets daily | | | |
| | 11-year-olds: n 2239 | | | | |
| Author and quality rating | Scotland | England | Response rate (%) | Dietary outcome | Data adjustment and statistical analysis |
|---------------------------|----------|---------|-------------------|----------------|----------------------------------------|
| **Currie et al.(62) (2005/6)** | 13-year-olds: n 1512 | 15-year-olds: n 1149 | 13-year-olds: n 2069 | 15-year-olds: n 1773 | Scotland: 65 Fruit daily England: Vegetables daily unknown Soft drinks daily |
| | Males: n 3032 | 11-year-olds: n 1691 | 13-year-olds: n 2256 | 15-year-olds: n 2198 | As above |
| | Currie et al.(63) (2009/10) | Males: n 3032 | 11-year-olds: n 1655 | 13-year-olds: n 2256 | 15-year-olds: n 2198 |
| | Females: n 3113 | 11-year-olds: n 181 | 13-year-olds: n 2166 | 15-year-olds: n 2116 | 11-year-olds: n 1185 |
| | Males: n 3319 | 13-year-olds: n 1185 | 15-year-olds: n 2567 | 15-year-olds: n 2116 | 11-year-olds: n 1118 |
| **Health Survey for England (children aged 5–15 years)** | Multistage cluster probability sample, 24 h recall, data weighted | Sproston and Primatesta(21) (2003) | Males: n 1350 | Females: n 1285 | 73 Fruit & vegetable intake (portions/d) Presented by gender Descriptive statistics |
| **Craig and Hirani(22) (2009)** | Craig and Mindell(23) (2013) | Males: n 1367 | Females: n 1312 | 701 | 62 As above Presented by age, gender, IMD, income Descriptive statistics |
| **Sproston and Primatesta(21) (2003)** | Health Survey for England (children aged 5–15 years) (comparable to English data) | Males: n 240 | Females: n 2514 | 1367 | 63 As above Presented by age and gender Descriptive statistics |
| **Corbett et al.(27) (2008)** | Corbett et al.(28) (2009) | Males: n 591 | Females: n 597 | 923 | 68 As above Presented by gender, income, NS-SEC Descriptive statistics |
| **Corbett et al.(29) (2008)** | Bromley et al.(29) (2003) | Males: n 593 | Females: n 837 | 608 | 716 | 69 As above Presented by age and gender Descriptive statistics |
| **Bromley et al.(26) (2013)** | Low Income Diet and Nutrition Survey – low-income households (2007) | Males: n 591 | Females: n 597 | 923 | 68 As above Presented by gender, income, NS-SEC Descriptive statistics |
| | | Males: n 593 | Females: n 837 | 608 | 716 | 69 As above Presented by age and gender Descriptive statistics |
| | | Presented for gender and household type Significance testing but analysis strategy not reported |
| **EURO-URHIS 2 (youth survey 14–16-year-olds) (2010)** | EURO-URHIS 2 (24–26) | Glasgow: n 296 | Greater Manchester: n 1128 | Merseyside: n 3466 | Unknown Regular fruit and vegetable or salad consumption (% participants) Data unadjusted Descriptive statistics |
| Poor | | | | | |
| | | | | | |

BW, body weight; RNI, Recommended Nutrient Intake; NMES, non-milk extrinsic sugars; SIMD, Scottish Index of Multiple Deprivation; NS-SEC, National Statistics Socioeconomic Classification; EAR, Estimated Average Requirement; IMD, Index of Multiple Deprivation.

Dates in parentheses represent the year(s) in which data were collected.
### Table 3: Overview of adult studies

| Author and quality rating | Scotland | England | Response rate (%) | Dietary outcome | Data adjustment and statistical analysis |
|---------------------------|----------|---------|-------------------|----------------|-----------------------------------------|
| **1946 British Birth Cohort Study/NSHD (1982)** | | | | | |
| Multistage cluster probability sample, 5 d prospective diary method (self-report) and 2 d interviewer-assisted recall (39 % complete data) using household measures to estimate portion size, data weighting not reported; North England = North England, Yorkshire and Humberside | | | | | |
| Braddon et al.(69) | | | | | |
| 36-year-old adults | | | | | |
| Fair | | | | | |
| Men: n 120 | Northern England Men: n 290 | Women: n 118 | Women: n 247 | | |
| **Health and Lifestyle Study (1984/5)** | | | | | |
| Multistage cluster probability sample, FFQ, self-report, data weighting not reported; Northern England = North West, Yorkshire and Humberside | | | | | |
| Whichelow et al.(76) | | | | | |
| Adults: n 8860 | | | | | |
| Fair | | | | | |
| Breakdown for regions unclear | | | | | |
| **Dietary and Nutritional Survey of British Adults (1987)** | | | | | |
| Multistage cluster probability sample, 7 d weighed diary, self-report, data weighting not reported; Northern England = North England, Yorkshire and Humberside | | | | | |
| Gregory et al.(36) | | | | | |
| Men: n 96 | Northern England Men: n 274 | Women: n 95 | Women: n 290 | | |
| **National Food Survey/Expenditure and Food Survey/Living Costs and Food Survey (household-level data)** | | | | | |
| Multistage cluster probability sample, food purchase data, self-report, data weighted | | | | | |
| MAFF(53) (1997) | | | | | |
| Fair | | | | | |
| Households: n 550 | Households: n 5280; | Individuals: n 1347 | Individuals: n 12 822 | | |
| MAF(54) (1998) | | | | | |
| Households: n 541 | Households: n 5073 | Individuals: n 1341 | Individuals: n 12 556 | | |
| MAF(55) (1999) | | | | | |
| Households: n 541 | Households: n 5252 | Individuals: n 1253 | Individuals: n 12 969 | | |
| MAF(56) (2000) | | | | | |
| Households: n 548 | Households: n 5097 | Individuals: n 1320 | Individuals: n 12 488 | | |
| Defra(44) (2001/2) | | | | | |
| Adults: n 822 | Households: n 5965 | Individuals: n 1431 | Individuals: n 14 913 | | |
| Defra(45) (2002/3) | | | | | |
| Households: n 585 | Households: n 5400 | Individuals: n 1346 | Individuals: n 12 906 | | |
| Defra(46) (2003/4) | | | | | |
| Households: n 585 | Households: n 5626 | Individuals: n 1340 | Individuals: n 13 502 | | |
| Defra(47) (2004/5) | | | | | |
| Households: n 1724 | Households: n 4680 | Individuals: n 3965 | Individuals: n 16 240 | | |
| Defra(48) (2005/6) | | | | | |
| Households: n 1708 | Households: n 16 199 | Individuals: n 3924 | Individuals: n 38 878 | | |
| Defra(49) (2006) | | | | | |
| Households: n 1589 | Households: n 14 450 | Individuals: n 4450 | Individuals: n 34 680 | | |
| Defra(50) (2007) | | | | | |
| Households: n 1499 | Households: n 13 889 | Individuals: n 2698 | Individuals: n 33 334 | | |
| Defra(51) (2008) | | | | | |
| Households: n 1583 | Households: n 13 437 | Individuals: n 3462 | Individuals: n 34 649 | | |
| Defra(52) (2009) | | | | | |
| Households: n 1545 | Households: n 13 678 | Individuals: n 3389 | Individuals: n 32 827 | | |

Dietary differences in Scotland and England.
### Table 3

| Author and quality rating | Scotland | England | Response rate (%) | Dietary outcome | Data adjustment and statistical analysis |
|---------------------------|----------|---------|-------------------|-----------------|------------------------------------------|
| **Scarborough et al.[79]** (2007–2009) | Combined sample from 2007, 2008, 2009 17,811 UK households, no regional breakdown provided (all household members over 7 years of age) | | | | |
| FAIR–GOOD | | | | | |
| **Defra[50]** (2010) | Households: n = 1512 Individuals: n = 3327 | Households: n = 13,300 Individuals: n = 31,920 | 50 | As in previous reports | Data unadjusted Descriptive statistics |
| **Defra[48]** (2011) | Households: n = 1512 Individuals: n = 3629 | Households: n = 13,574 Individuals: n = 33,935 | 54 | As above | As above |
| **Defra[39]** (2012) | Households: n = 1451 Individuals: n = 3482 | Households: n = 13,843 Individuals: n = 34,608 | 52 | As above | As above |
| **Defra[49]** (2013) | Households: n = 1395 Individuals: n = 3069 | Households: n = 13,791 Individuals: n = 33,098 | 48 | As above | As above |
| **National Diet and Nutrition Survey 19–64 year olds (2001/2)** | Multistage cluster probability sample, 7 d weighed record, dietary interview, 24 h urinary sample, self-report and objective (for urine sample), data weighted | | | | |
| **Haleem et al.[74]** | Men: n = 123 Women: n = 451 | | 47 | Antioxidant intake from fruit & vegetables (μmol/d) | Data unadjusted Descriptive statistics |
| **Henderson et al.[31–33]** | Dietary interview: men, n = 80; women, n = 111 Weighed record: men, n = 53; women, n = 70 | Northern England Dietary interview: men, n = 267; women, n = 341 Weighed record: men, n = 19; women, n = 256 | 47 | Food and food groups (g/week, % consumers), energy intake (kJ/d), fibre intake (g/d), macronutrient intake (g/d, % energy), micronutrient intake (mg/d or μg/d) | Data unadjusted Descriptive statistics |
| **Ji et al.[70]** | Men: n = 53 Women: n = 70 | Northern England Men: n = 195 Women: n = 256 | 47 | Na Intake (mg/d) Urinary Na excretion (mmol/d) | Gender, smoking habit, social class, marital status, education, age, BMI, alcohol drinking, energy intake Bayesian geo-additive mixed models |
| **Sodium surveys – England and Scotland** | Participants recruited via probability sample in Health Survey for England 2005, Scottish Health Surveys 2003 and 2008, National Diet and Nutrition Survey rolling programme, telephone interview and nurse visit, 24 h urinary Na, data weighted | | | | |
| NatCen & UCL[72] (2005/06) | Men: n = 243 Women: n = 331 | | 20 | Salt intake (g/d) | Presented by age and gender Descriptive statistics |
| Poor–fair | Men: n = 320 Women: n = 382 | | 32–34 | Salt intake (g/d) | As above |
| ScotCen Social Research[68] (2009) | Households: n = 58 Individuals: n = 50 | | | | |
| Poor–fair | Men: n = 250 Women: n = 297 | | 24 | Salt intake (g/d) | As above |
| Sadler et al.[73] (2011) | Poor–fair | | | | |
| **Low Income Diet and Nutrition Survey (2007)** | Multistage cluster probability sample, 24 h recall, interviewer administered face-to-face, data weighted | | | | |
| Nelson et al.[55] | Men: n = 120 Women: n = 194 | | 55 | Food and food groups (g/d, % consuming), fruit & vegetable intake (portions/d, % consuming 5+ portions/d), energy intake (MJ/d, EAR), macronutrient intake (g/d), micronutrient intake (mg/d or μg/d, and RNI) | Presented by gender and household type Significance testing but analysis strategy not reported |
| Low-income individuals | Men: n = 609 Women: n = 1222 | | | | |
| FAIR | | | | | |
| **Health Survey for England (HSfE)** | Multistage cluster probability sample, 24 h recall, interviewer administered face-to-face, data weighted | | | | |
| Shelton[50] (2003) | SHS 2003: n = 8148 HSfE 2003: n = 14836 | | % eating 5+ fruit & vegetable portions/d OR for eating 5+ fruit & vegetable portions/d | Socio-economic status, income, age, urban residence, smoking Logistic regression |
| Good–fair | HSfE: 66 SHS: 60 | | | Presented by age, gender, NS-SEC, income Descriptive statistics |
| Craig et al.[24] (2008) | Men: n = 7325 Women: n = 7682 | | 64 | Fruit & vegetable intake (portions/d) % eating 5+ fruit & vegetables daily | Presented by age, gender, NS-SEC, income Descriptive statistics |
| Fair | Households: n = 64 Boost: 73 | | | | |
children in Scotland reported eating fruit daily in 2001/2\textsuperscript{(61)}, but this pattern was demonstrated only for 11-year-olds, not 13- and 15-year-olds in 2005/6\textsuperscript{(62)} and 2009/10\textsuperscript{(63)}. In line with the patterns identified in other studies, a lower percentage of children in Scotland reported eating vegetables daily in 2005/6\textsuperscript{(62)} and 2009/10\textsuperscript{(63)}, and a higher percentage of children living in Scotland reported drinking sweetened beverages daily in 2001/2\textsuperscript{(61)} and 2005/6\textsuperscript{(62)}. By 2009/10, a higher proportion of English children reported drinking them daily\textsuperscript{(63)}. The EURO-URHIS 2 study found little difference in regular fruit and vegetable consumption between teenagers living in Glasgow and Greater Manchester; however, consumption was higher in Merseyside\textsuperscript{(64–66)}.

In the only study to examine overall diet quality as a single variable, Watt et al.\textsuperscript{(60)} analysed the percentage of pre-school children meeting five dietary parameters (recommended nutrient intakes for Fe, Zn, vitamins A and C, and percentage of energy from non-milk extrinsic sugars of less than 10%). Their analysis showed that children living in Scotland were less likely to meet one or more of the recommended dietary parameters.

### Study quality

Overall study quality ranged from ‘poor’ to ‘good-fair’. The main limitations of the studies were that sample sizes were often small in Scotland\textsuperscript{(11,21,45–47,52,53,67,68)}, limiting the ability to find statistically significant differences, and results often did not adjust for confounders\textsuperscript{(21–24,26–30,36,37,55,61–66)} or descriptive results were presented only\textsuperscript{(21–24,26–30,36,37,58,60–63)}. The validity of dietary measures was less problematic. Only two surveys (with results reported across six reports\textsuperscript{(61–66}) used a food frequency measure with no information on whether these measures had been validated. The remaining studies used either weighed 4d or 7d diaries\textsuperscript{(50,36,37,58–60)} or interviewer-assisted 24 h recalls\textsuperscript{(21–24,26–29,55,57,58)}.

### Adults

Six studies presented statistically significant findings of differences between the diets of adults living in Scotland and adults living in England. Differences in energy intake appeared to vary by gender. For example, Gregory et al.\textsuperscript{(35)} reported that energy intake for men in Scotland was 210 kcal/d (879 kJ/d) lower compared with men in the North of England, but no differences were reported for women. Braddon et al.\textsuperscript{(69)} found a similar result, with men living in Scotland consuming 0·4 MJ/d less than men living in Northern England. However, women living in Scotland in the same survey had higher energy intakes (0·3 MJ/d) than women in England.

There were no notable significant differences in macronutrient intakes, other than fibre. Fibre intake (NSP) was 1·2 g/d lower in women living in low-income households in Scotland compared with similar women in England\textsuperscript{(55)} and 17% fewer women in Scotland achieved...
### Table 4 Significant results from studies with child populations

#### British Birth Cohort (1950)
**Prynne et al.**

| Dietary phylloquinone intake | Scotland | Northern England | P  |
|-----------------------------|----------|------------------|----|
| mg/d                        | 27       | 35               | <0.05 |
| μg/kg BW/d                  | 1.6      | 2.1              | <0.05 |
| % <1 μg/kg BW/d             | 33       | 26               | <0.05 |

**Prynne et al.**

| Child consumption of food groups at least once (%) | Scotland | Northern England | Adjusted OR | Daily intakes, adjusted means | Scotland | Northern England | P  |
|---------------------------------------------------|----------|------------------|-------------|-----------------------------|----------|------------------|----|
| Porridge                                          | 30       | 11               | 0.3         | 0.2, 0.4                    | 5.7      | 6.2              | <0.0001 |
| Cake, biscuits                                    | 52       | 60               | 1.4         | 1.1, 1.7                    | 164      | 187              | <0.0001 |
| Eggs                                              | 64       | 51               | 0.6         | 0.5, 0.7                    | 56       | 64               | <0.0001 |
| Spreading fats                                    | 76       | 83               | 1.5         | 1.2, 1.9                    | 60       | 65               | <0.0001 |
| Fried foods                                       | 30       | 43               | 1.8         | 1.4, 2.3                    | 7.2      | 7.8              | <0.0001 |
| Bacon                                             | 17       | 28               | 1.9         | 1.5, 2.5                    | 160      | 171              | <0.0001 |
| Vegetables                                        | 59       | 80               | 3.0         | 2.4, 3.8                    | 1668     | 1769             | 0.005  |
| Fruit                                             | 34       | 41               | 1.4         | 1.1, 1.7                    | 498      | 612              | 0.008  |
| Orange juice                                      | 6        | 9                | 1.6         | 1.1, 2.5                    | 0.69     | 0.73             | 0.001  |
| Soup                                              | 36       | 4                | 0.1         | 0.0, 0.1                    | 24       | 32               | <0.0001 |

**Diets of British School Children (1983)**

| Scotland | Northern England | 10/11-year-olds | 14/15-year-olds | Scotland | Northern England | 10/11-year-olds | 14/15-year-olds |
|----------|------------------|-----------------|-----------------|----------|------------------|-----------------|-----------------|
| Vegetables (g/week)                              | 469             | 588             | 2127           | 1851     | 2171             | 1837            | 2118            | 1809           |
| Cakes (g/week)                                   | 121             | 159             | 159            | 200      | 354              | 500             | 247             | 395            |
| Biscuits (g/week)                                | 159             | 200             | 354            | 500      | 247              | 395             | 453             | 423            |
| Pudding (g/week)                                 | 165             | 82              | 165            | 82       | 111              | 63              | 151             | 196            |
| Other meat products (g/week)                     | 2127            | 1851            | 159            | 200      | 354              | 500             | 247             | 395            |
| Milk (g/week)                                    | 2127            | 1851            | 159            | 200      | 354              | 500             | 247             | 395            |
| Cheese (g/week)                                  | 111             | 63              | 111            | 63       | 151              | 196             | 218             | 251            |
| Sausages (g/week)                                | 146             | 119             | 146            | 119      | 133              | 101             | 142             | 120            |
| Chocolate (g/week)                               | 133             | 101             | 133            | 101      | 142              | 120             | 142             | 120            |
| Sweets (g/week)                                  | 431             | 254             | 431            | 254      | 431              | 254             | 191             | 144            |
| Soup (g/week)                                    | 431             | 254             | 431            | 254      | 431              | 254             | 191             | 144            |
| Fat (g/d)                                        | 47.2            | 47.6            | 47.2           | 47.6     | 47.2             | 47.6            | 47.2            | 47.6           |
| Retinol (μg/d)                                   | 450             | 570             | 450            | 570      | 450              | 570             | 450             | 570            |
| Carotene (μg/d)                                  | 1000            | 1430            | 1000           | 1430     | 1000             | 1430            | 1000            | 1430           |
| Retinol equivalents (μg/d)                       | 620             | 810             | 620            | 810      | 620              | 810             | 620             | 810            |
| Vitamin D (μg/d)                                 | 1.24            | 1.54            | 1.24           | 1.54     | 1.24             | 1.54            | 1.24            | 1.54           |
| Pyridoxine (mg/d)                                | 1.14            | 1.17            | 1.14           | 1.17     | 1.14             | 1.17            | 1.14            | 1.17           |
| Vitamin C (mg/d)                                 | 42.5            | 43.6            | 42.5           | 43.6     | 42.5             | 43.6            | 42.5            | 43.6           |
Table 4 Continued

1970 British Cohort Study (1986)
Crawley (59) (1986)
16/17-year-olds; Scotland: males, n 85; females, n 133; England/Wales: males, n 573; females, n 824

| Nutrient intake | Scotland | England/Wales | P   | Nutrient intake | Scotland | England/Wales | P   |
|-----------------|----------|---------------|-----|-----------------|----------|---------------|-----|
| NSP (g/d)       | 14.5     | 16.2          | <0.001 | NSP (g/d)       | 11.4     | 13.0          | <0.001 |
| Mg (mg/d)       | 312      | 328           | <0.01  | Mg (mg/d)       | 247      | 262           | <0.01  |
| Cu (mg/d)       | 1.56     | 1.64          | <0.01  | P (mg/d)        | 1068     | 1121          | <0.01  |
| Retinol (µg/d)  | 979      | 1205          | <0.001 | Retinol (µg/d)  | 796      | 974           | <0.001 |
| Carotene (µg/d)| 1540     | 2122          | <0.001 | Carotene (µg/d) | 1490     | 2032          | <0.001 |
| Riboflavin (mg/d)| 1.91  | 2.05          | <0.01  | Riboflavin (mg/d)| 1.35     | 1.47          | <0.001 |
| Vitamin B6 (mg/d)| 2.07  | 2.13          | <0.01  | Vitamin B12 (µg/d)| 4.73     | 5.33          | <0.01  |
| Folic acid (µg/d)| 299   | 314           | <0.01  |                  |          |               |      |

| Food group intake | Scotland | England/Wales | P   | Food group intake | Scotland | England/Wales | P   |
|-------------------|----------|---------------|-----|-------------------|----------|---------------|-----|
| Beer (%)          | 28       | 37            | <0.01 | Beer (%)          | 13       | 25            | <0.01 |
| Fizzy drinks (not low-calorie) (%) | 91 | 75 | <0.001 | Beer intake (g/d) | 240 | 190 | <0.01 |
| Squash (g/d)      | 152      | 219           | <0.01 | Hot chocolate (%) | 13       | 24            | <0.01 |
| Hot chocolate (%) | 11       | 22            | <0.01 | White bread (g/d) | 62       | 91            | <0.01 |
| All bread (g/d)   | 127      | 99            | <0.01 | Breakfast cereals (g/d) | 14 | 64 | <0.01 |
| White bread (g/d) | 99       | 93            | <0.01 | Skimmed milk (%)  | 4        | 14            | <0.01 |
| Pasta and rice (%)| 37       | 53            | <0.01 | Polysaturated fat spreads (%) | 10 | 21 | <0.01 |
| Skimmed milk (%)  | 4        | 9             | <0.01 | Non-fried potatoes (%) | 23 | 44 | <0.001 |
| Non-fried potatoes (%) | 34 | 50 | <0.01 | Chips (g/d) | 97 | 71 | <0.001 |
| Chips (g/d)       | 121      | 101           | <0.001 | All veg (%)      | 94       | 97            | <0.001 |
| All veg (%)       | 80       | 93            | <0.001 | All veg (g/d)    | 56       | 83            | <0.001 |
| All veg (g/d)     | 57       | 84            | <0.01 | Green veg (g/d)  | 26       | 50            | <0.001 |
| Green veg (g/d)   | 22       | 46            | <0.01 | Carrots (g/d)    | 24       | 47            | <0.001 |

National Diet and Nutrition Survey (NDNS)
Watt et al. (60) (1993)
1.5–4.5-year-olds: Scotland, n 188; Northern England, n 466

| % children meeting one or none of 5 dietary parameters | Scotland | Northern England | P   |
|--------------------------------------------------------|----------|------------------|-----|
|                                                        | 54       | 49               | <0.001 (for overall regional comparison only) |

Dietary differences in Scotland and England
**Table 4 Continued**

**Gregory and Lowe**<sup>(36)</sup> (1997)

4–18-year-olds; Scotland: males, n 68; females, n 69; North England: males, n 243; females, n 217

Significant differences discussed (but not given)

| Foods consumed | Scotland | Northern England | Foods consumed | Scotland | Northern England |
|----------------|----------|------------------|----------------|----------|------------------|
| Other cereals (not wholegrain or high fibre) (g/week) | 193       | 189               | Other cereals (not wholegrain or high fibre) (g/week) | 121       | 141               |
| (% consumers) | (83)     | (75)              | (% consumers) | (23)     | (28)              |
| Other white fish and dishes (g/week) | 133       | 176               | Other white fish and dishes (g/week) | 137       | 180               |
| (% consumers) | (5)      | (7)               | (% consumers) | (5)      | (16)              |
| Green beans (g/week) | 38       | 50                | Green beans (g/week) | 67       | 48                |
| (% consumers) | (4)      | (10)              | (% consumers) | (5)      | (11)              |
| Leafy green vegetables (g/week) | 107       | 78                | Leafy green vegetables (g/week) | 99       | 90                |
| (% consumers) | (20)     | (31)              | (% consumers) | (28)     | (44)              |
| Fried and roast potatoes (g/week) | 124       | 140               | Fried and roast potatoes (g/week) | 136       | 127               |
| (% consumers) | (31)     | (44)              | (% consumers) | (32)     | (41)              |
| Sauces, pickles, gravies, condiments (g/week) | 95       | 144               | Sauces, pickles, gravies, condiments (g/week) | 117       | 146               |
| (% consumers) | (73)     | (92)              | (% consumers) | (70)     | (95)              |

**Low Income Diet and Nutrition Survey (2007)**

Nelson et al.<sup>(55)</sup>

Low-income households; Scotland, males, n 39; females, n 39; England: males, n 289; females, n 313

| Males | | | | Females | | | |
|-------|--------------------------|--------------------------|------------------|-----------------------|--------------------------|------------------|--------------------------|
|       | Scotland | England | No significance levels reported | Scotland | England | No significance levels reported |       |       |       |
| Ca (% with intake below LRNI) | 0 | 6 | | Fruit & vegetable intake (portions/d) | 1-4 | 2 | 1 |
| K (% with intake below LRNI) | 0 | 11 | | (% consuming 5+ portions/d) | (0) | (4) | |
| Zn (% with intake below LRNI) | 6 | 16 | | (median intake, mg/d) | (6.7) | (6.4) | |

LRNI, Lower Nutrient Reference Intake.

Dates in parentheses represent the year in which data were collected.

*Geometric mean.
**Table 5** Significant results from studies with adult populations

**1946 British Birth Cohort Study/NSHD (1982)**
Braddon et al.\(^{(35)}\)
36-year-olds; Scotland: men, n 120; women, n 118; North England: men, n 290; women, n 247

| Intake                | Males (mean values) | P     | Intake                | Females (mean values) | P     |
|-----------------------|---------------------|-------|-----------------------|-----------------------|-------|
| Energy (MJ/d)         | Scotland            | 10-0  | Northern England      | 10-4                  | <0-01 |
|                       |                     |       |                       |                       |       |
| Fat (g/d)             | 102-4               | <0-01 | Total fibre (g/d)     | 261                   | <0-001|
| Carbohydrate (g/d)    | 269                 | <0-01 | Ca (mg/d)             | 10-0                  | <0-01 |
| Total fibre (g/d)     | 18-1                | <0-01 | Vitamin C (mg/d)      | 727                   | <0-001|
| Cereal fibre (g/d)    | 8-1                 | <0-01 |                      |                       |       |
| Added sugar (g/d)     | 71-1                | <0-01 |                      |                       |       |
| Calcium (mg/d)        | 904                 | <0-01 |                      |                       |       |
| Vitamin C (mg/d)      | 57-0                | <0-001|                      |                       |       |

**Dietary and Nutritional Survey of British Adults (1987)**
Gregory et al.\(^{(35)}\)
Scotland: men, n 96; women, n 95; North England: men, n 274; women, n 290

| Intake                | Males (deviation from grand mean)† | P     | Intake                | Females (deviation from grand mean)† | P     |
|-----------------------|-----------------------------------|-------|-----------------------|-------------------------------------|-------|
| Energy (kcal/d)       | Scotland                          | −159  | Northern England      | 22                                  | <0-05 |
|                       |                                   |       |                       |                                     |       |
| Energy (kcal/d)*      | −149                              | <0-05 | Na (mg/d)             | 203                                 | 57    | <0-01 |
| Sugars (g/d)          | −7-7                              | <0-05 | Na (mg/d)*            | 211                                 | 50    | <0-01 |
| Fibre (g/d)           | −1-6                              | <0-01 | Vitamin B\(_6\) (mg/d) | −0-87                             | <0-05 |
| Fibre (g/d)*          | −1-6                              | <0-01 | Vitamin B\(_6\) (mg/d)* | −0-98                           | <0-05 |
| Fat (g/d)             | 0-0                               | <0-05 |                      |                                     |       |
| Fat (% food energy/d) | 0-47                              | <0-05 |                      |                                     |       |
| Saturated fat         | 0-36                              | <0-01 |                      |                                     |       |
| (% food energy/d)     |                                   |       |                      |                                     |       |
| Fat (% food energy/d)*| 0-80                              | <0-05 |                      |                                     |       |
| Saturated fat         | 0-64                              | <0-05 |                      |                                     |       |
| (% food energy/d)*    | 0-5                               | <0-01 |                      |                                     |       |
| Ca (mg/d)             | 21                                | <0-01 |                      |                                     |       |
| Na (mg/d)             | 188                               | <0-01 |                      |                                     |       |
| Ca (mg/d)*            | 14                                | <0-01 |                      |                                     |       |
| Na (mg/d)*            | 198                               | <0-01 |                      |                                     |       |
| Vitamin B\(_6\) (mg/d) | 0-11                          | <0-05 |                      |                                     |       |
| Folate (µg/d)         | −9-4                              | <0-05 |                      |                                     |       |
| Vitamin B\(_6\) (mg/d)* | 0-19                      | <0-05 |                      |                                     |       |
| Folate (µg/d)*        | −12-8                             | <0-05 |                      |                                     |       |

**National Diet and Nutrition Survey 19–64 year olds (2000/1)**
Ji et al.\(^{(70)}\)
Scotland: men, n 53; women, n 70; Northern England: men, n 195; women, n 256
Results presented diagrammatically only. Results showed statistically significant positive spatial effect for respondents in Scotland compared with the posterior mean for dietary Na intake and urinary Na intake. No significant differences from the posterior mean were observed for respondents from Northern England. Highest UK levels of dietary Na intake and urinary Na were present in Scotland. Second highest levels were observed in Northern England

**Health Survey for England (2003) & Scottish Health Survey (2003)**
Shelton\(^{(56)}\)
Scottish Health Survey 2003: n 8148; Health Survey for England 2003: n 14 836

| % population          | Males | Females | Odds of Manchester respondents eating 5+ portions of fruit & vegetables/d v. Glasgow respondents (controlling for NS-SEC, equivalised income and age) |
|-----------------------|-------|---------|----------------------------------------------------------------------------------------------------------------------------------|
|                       | Scotland | England | Scotland | England | OR | 95% CI |
| Eating 5+ fruit & veg/d | 20     | 22      | 22       | 26      | 0.67 | 0.47, 0.94 | Not significant |
the recommended daily minimum compared with women in England. More mixed results for fibre were found by Braddon et al., with men in Scotland reporting lower fibre intakes than those in Northern England, but women in Scotland reporting higher intakes than women in Northern England.

Few studies reported statistically significant differences in micronutrient intakes. Na intake was higher in Scotland than in English regions for men in 1987 (dietary intake), with this difference still present in 2001 (dietary intake and urinary Na). The four dietary sodium surveys undertaken in Scotland and England between 2006 and 2011 found that salt intake (measured from urinary Na levels) was 0.5 g/d higher in men in Scotland in 2006 compared with men in England. Salt intakes were higher for both men (0.7 g/d) and women (0.5 g/d) living in Scotland in 2009 compared with those in England in 2011. Although these differences were not tested for significance, they indicate that earlier differences have remained.

For other micronutrients, consistent trends were identified, such as lower intakes in Scotland for vitamins A, C, D and E; however, these differences have narrowed over time. In contrast, Haleem et al. found that antioxidant intake in Scotland was higher than that in Northern England, particularly among men.

The most consistent differences for food consumption were for fruit and vegetable intake. Shelton found that consumption of five or more portions of fruit and vegetables daily was lower in Scotland for men and women than in England. No significant differences were identified; however, the odds of eating five or more portions daily for men or women was greater in Cheshire and Merseyside compared with Greater Glasgow. In Greater Manchester men were less likely to eat five portions of fruit and vegetables each day compared with Greater Glasgow. Consistent findings were reported, although not compared statistically, in the 2008 Scottish Health Survey and the Health Survey for England.

Respondents from England ate an average of half a portion more of fruit and vegetables daily than those in Scotland, and a lower percentage of respondents in Scotland reported eating five or more portions of fruit and vegetables daily (men: difference 5.1%, 95% CI 2.8, 7.4%;}

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**Table 5** Continued

**Low Income Diet and Nutrition Survey (2007)**

| Intake                  | Scotland | England |
|-------------------------|----------|---------|
| Fruit (portions/d)      | 1.9      | 2.5     |
| (% consuming 5+ portions/d) | 2       | 9       |
| Na (mg/d)               | 3250     | 2872    |
| Vitamin D (median % RNI) | 26      | 29      |
| Vitamin A (median % RNI) | 23      | 29      |

**National Food Survey/Expenditure and Food Survey/Living Costs and Food Survey (2007–2009)**

| Intake                  | Scotland | England |
|-------------------------|----------|---------|
| Energy (kcal/d)         | 2375     | 2282    |
| Total fat (g/d)         | 98.1     | 94.6    |
| Saturated FA (g/d)      | 37.8     | 35.7    |
| MUFA (g/d)              | 36.3     | 35.3    |
| PUFA (g/d)              | 17.5     | 17.3    |
| Cholesterol (mg/d)      | 268      | 265     |
| Fibre (g/d)             | 15.0     | 15.1    |
| Salt (g/d)              | 7.5      | 7.0     |
| Fruit (g/week)          | 1205     | 1270    |
| Vegetables (g/week)     | 951      | 1190    |

NSHD, National Survey of Health and Development; NS-SEC, National Statistics Socioeconomic Classification; RDM, recommended daily minimum; RNI, Recommended Nutrient Intake.

Dates in parentheses represent the year in which data were collected.

*Adjusted for behavioural variables: cigarette smoking, food supplements, drinking behaviour, health-related diet.

† The grand mean is the mean of the means for each regional sub-sample.
women: difference = 5.2%, 95% CI 3.1, 7.3%). Similar findings were identified in a range of the included studies (21, 28, 35, 38–55, 76). Other differences noted were higher intakes of processed potatoes and meat, and soft drinks in Scotland (21, 28, 35, 38–55, 76). In England intakes of carcass meat (38–54, 63) and fresh potatoes (52–54, 63) were higher. Reported confectionery intake has been higher in Scotland compared with England in more recent years (38, 49, 55).

**Study quality**

Studies with adult populations had similar issues with study quality as those reported for children: low sample sizes in Scotland (31, 32, 35, 35, 55, 68–70, 74), lack of adjustment for confounders (22–24, 26–28, 31–33, 38–55, 68, 69, 71–74, 76) and limited statistical analysis (6, 7, 15–17, 22–24, 27–30, 32, 34–36, 44–54, 57–59, 68, 75, 76, 77). The largest sample sizes were in reports from the Scottish Health Survey (26–28), the Health Survey for England (22–24), and the National Food Survey/Expenditure and Food Survey/Living Costs and Food Survey (38–54), which had no statistical testing of differences between the two countries and, in the case of the latter, were reliant on household rather than individual-level data. Response rates were also relatively low for a number of studies (68, 70, 72–74) and although the data were weighted to account for this on key demographic variables, it increases the likelihood of bias in the results.

**Discussion**

The current rapid review study was a response to NHS Health Scotland’s request for an overview of the evidence on whether aspects of diet and nutrition differ, or have differed historically, between Scottish and English populations. Examining the current and historical differences in food and nutrient intakes in Scotland and England, we identified for Scotland lower intakes of fruit and vegetables, fibre and vitamins, and higher intakes of salt. Differences in fruit and vegetable intake appear to have persisted over time, as have differences in micronutrient intakes. There were few other consistent differences in food consumption over time that could be identified from the included studies.

What is clear is that dietary differences between Scotland and England are apparent from the early years, as demonstrated in the literature reporting on surveys of pre-school children from 1950 and 1992 (50), and appear to continue throughout adolescence (50) and into adulthood (9, 56). In line with evidence that suggests that eating habits are established in childhood (78, 79), our results indicate that in Scotland nutritional disparities with England begin in the early years and persist. The impact of nutritional deficiencies, such as lower fruit and vegetable consumption, was highlighted by Oyebode et al. (80) in an analysis of Health Survey for England data. Higher fruit and vegetable consumption was associated with lower likelihood of all-cause, cancer and cardiovascular mortality. The lowest mortality risk from any cause was identified for those eating seven or more portions of fruit and vegetables daily, with consumption of vegetables, salad and fresh or dried fruit associated with decreased mortality. Similar results were found in an Australian study, which again highlighted the protective effect of seven or more daily portions of fruit and vegetables on all-cause mortality (81). A systematic review and meta-analysis of 142 prospective studies concluded that the greatest protective effect for all-cause mortality and CVD resulted from consumption of ten portions of fruit and vegetables per day (82).

There was little evidence to determine whether there were differences in dietary intake in the cities of and/or regions surrounding Glasgow, Liverpool and Manchester. These cities have been used as exemplars in demonstrating the inequalities in mortality outcomes that exist between Scotland and England (5). Only three studies tested differences for Scotland and England statistically at a national level (9, 55, 56). The majority of studies reported data from Northern England. As Northern England has a more similar demographic profile to Scotland than southern English regions, it is likely to minimise the dietary differences that exist at a national level. The same is true of studies reporting data from England and Wales jointly. Caution is urged also as the dietary data (except for the sodium surveys which measured Na excretion in urine) are self-reported or reported by parents and carers of children, and prone to reporting bias. It is recognised, for example, that obese adults tend to under-report energy intake (83, 84). Reported energy intake tended to be lower in Scotland, but it is unclear whether this reflects lower intakes or a greater tendency to under-report within Scotland. For example, Scotland has not reported lower levels of overweight and obesity, which would be the expected outcome of lower energy intakes (75). At a population level there are not yet objective measures of dietary intake that can be utilised (85, 86), however, we would not expect dietary assessment data collected in Scotland to be less accurate than those collected in England. Weighed intake (considered the gold standard) was used in many of the studies, with only a small number using non-validated food frequency measures. Nevertheless, under- and misreporting are still likely to occur even with gold standard measures (87). Additional limitations identified were relatively limited statistical analysis and a failure to adjust for key confounders.

**Study limitations**

The main limitation of the current rapid review was that a more extensive search of additional databases and grey literature was not possible due to commissioners’ time constraints. Within the scope of the rapid review, the team took the decision to limit reports to those that were easily
accessible within the limited review period of 4 months. We therefore did not include historical reports from the National Food Survey which began in 1940. Our first included report from this survey is from 1997, meaning that over 50 years of evidence on food expenditure was not included. These reports provided descriptive data only, with no adjustment for confounding factors. We therefore believe that these reports would not have altered the main findings of the review, which focused more on studies that tested for statistical differences between Scotland and England.

The review did identify a number of large-scale studies, such as the National Diet and Nutrition Survey, the Health Survey for England and the Scottish Health Survey, which provide data from representative samples in these regions. In recognition of the need to increase Scottish samples in national surveys, the National Diet and Nutrition Survey rolling programme included a Scottish boost sample for 2008/9 to 2011/12. The report from these data was excluded from the review as it only compared results from respondents living in Scotland with respondents from the full UK sample rather than England specifically. Differences identified included lower energy intakes in women aged 19–64 years living in Scotland and, in line with the review findings, lower intakes of fibre and vegetables across age groups and gender among respondents living in Scotland. Given the cost required, and the interest in academic and policy groups of undertaking robust dietary surveys, it is likely that the review identified all relevant studies. One exception to this is food purchase market analysis data such as those collected by Kantar Worldpanel UK. Scottish data have only recently been published and were outside the time frame of the original review; however, there is no equivalent report available on English data.

An additional limitation was that only a single reviewer decided on study inclusion after reading the full text and a single reviewer extracted data. There is a possibility that bias may have been introduced into the information selected due to this compromise. We believe that the risk was minimised through a clear protocol agreed by all authors before the review took place. In addition, the project lead provided an additional opinion on any areas of uncertainty.

Conclusions

There were limited comparisons of dietary intake between Scotland and England in the published literature and only two studies that allowed for comparisons at more local levels. In general, there were lower intakes of fruit and vegetables, vitamins and fibre in Scotland compared with England. Increasing fruit, vegetable and fibre intakes are key targets within the Scottish Dietary Goals, and the review results suggest that both adults and children need to be encouraged through policy action and implementation to improve in these areas. Review results were limited by small sample sizes for Scotland and limited adjustment for confounding factors. It is recognised that dietary quality is poorer in populations experiencing higher levels of deprivation. In addition, dietary differences exist with regard to age and gender. It is essential, therefore, that comparisons between Scotland and England are examined using large representative samples, with data that have been collected robustly and allow for confounders to be taken into account. Such work is necessary to provide insight into the potential causes of excess mortality in Scotland compared with England and to contribute to policy recommendations to address these inequalities.

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Supplementary material

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