**Supplementary Materials**

**Table S1. Individual foods measured in the National Diet and Nutrition Survey (NDNS) contained within food groups used in analyses**

|  |  |  |
| --- | --- | --- |
| **Summary Food Group** | **Detailed Food Group** | **Individual Foods Measured in NDNS** |
| Red meat | Beef | Other beef and veal |
| Processed beef | Homemade meat pies and pastries |
| Manufactured beef products |
| Burgers and kebabs |
| Meat pies and pastries |
| Other manufactured meat products |
| Pork | Other pork |
| Processed pork | Bacon and ham ready meals |
| Other bacon and ham |
| Manufactured pork products |
| Sausage ready meals |
| Other sausages |
| Lamb | Manufactured lamb products |
| Other lamb |
| Other red meat | Liver |
| Other meat |
| White meat | Poultry | Other chicken and turkey |
| Processed white meat | Manufactured chicken and turkey |
| Manufactured chicken including ready meals |
| Fish | Fish | White fish coated or fried |
| Manufactured white fish products |
| Other white fish |
| Manufactured shellfish products |
| Other shellfish |
| Manufactured canned tuna products |
| Other canned tuna |
| Manufactured oily fish products |
| Other oily fish |
| Dairy and eggs | Milk and milk products | Whole milk |
| Semi skimmed milk |
| Skimmed milk |
| Infant formula |
| Cream |
| Other milk |
| Yogurt |
| Fromage frais |
| Dairy desserts |
| 1% fat milk |
| Cheese | Cottage cheese |
| Other cheese |
| Ice cream | Ice cream |
| Eggs | Manufactured egg products |
| Other eggs |
| Cereals | Bread | White bread |
| Wholemeal bread |
| Other bread |
| Brown granary and wheatgerm bread |
| Breakfast cereals | Wholegrain and high fibre breakfast cereals |
| Other breakfast cereals |
| Pasta and pizza | Pizza |
| Manufactured pasta |
| Other pasta |
| Rice | Manufactured rice |
| Other rice |
| Other cereals | Other cereals |
| Potatoes | Unprocessed potatoes | Other fried or roast potatoes |
| Other potato products |
| Other potatoes |
| Processed potatoes | Chips purchased |
| Other manufactured potato products |
| Vegetables | Other vegetables | Raw carrots |
| Salad and other raw vegetables |
| Peas not raw |
| Leafy green vegetables not raw |
| Carrots not raw |
| Meat alternatives |
| Other manufactured vegetable products |
| Other vegetables |
| Tomatoes | Raw tomatoes |
| Tomatoes not raw |
| Beans and pulses | Beans and pulses | Green beans not raw |
| Baked beans |
| Beans and pulses |
| Fruit | Fruit | Apples and pears not canned |
| Citrus fruit not canned |
| Bananas |
| Canned fruit in juice |
| Canned fruit in syrup |
| Other fruit not canned |
| Fats and oils | Butter | Butter |
| Margarine and low fat spread | Polyunsaturated margarine |
| Polyunsaturated low fat spread |
| Low fat spread not polyunsaturated |
| Block margarine |
| Soft margarine not polyunsaturated |
| Reduced fat spread polyunsaturated |
| Reduced fat spread not polyunsaturated |
| Cooking oil | Polyunsaturated oils |
| Other cooking fats and oils |
| Sweet and sugary foods | Biscuits | Biscuits manufactured |
| Biscuits homemade |
| Buns and cakes | Buns, cakes and pastries manufactured |
| Buns, cakes and pastries homemade |
| Chocolate and sweets | Sugar confectionery |
| Chocolate confectionery |
| Sugar and sweet spreads | Sugar |
| Sweet spreads, fillings and icing |
| Puddings and pies | Cereal based milk puddings manufactured |
| Cereal based milk puddings homemade |
| Sponge puddings manufactured |
| Sponge puddings homemade |
| Other cereal based puddings manufactured |
| Other cereal based puddings homemade |
| Fruit pies manufactured |
| Fruit pies homemade |
| Savoury snacks | Soup | Soup manufactured |
| Soup homemade |
| Preserves | Preserves |
| Crisps and savoury snacks | Crisps and savoury snacks |
| Soft drinks | Soft drinks | Soft drinks concentrated |
| Soft drinks carbonated |
| Soft drinks still |
| Soft drinks low calorie concentrated |
| Soft drinks low calorie carbonated |
| Soft drinks low calorie still |
| Fruit juice | Fruit juice |
| Alcoholic drinks | Alcoholic drinks | Liqueurs |
| Spirits |
| Wine |
| Fortified wine |
| Low alcohol and alcohol free wine |
| Beers and lagers |
| Low alcohol and alcohol free beer |
| Cider and perry |
| Alcoholic soft drinks |
| Coffee | Coffee | Coffee |
| Mineral water | Mineral water | Bottled water |
| Tea | Tea | Tea |
| Herbal tea |
| Nuts and seeds | Nuts and seeds | Nuts and seeds |

**Table S2. Greenhouse gas emissions estimation and data sources (lifecycle assessment including all stages from food production, packing, distribution, storage/refrigeration, transportation (farm-to-outlet and retailer-to-home), food handling/preparation (incl. trimmings and cooking losses), and consumer waste (incl. spoilage and plate waste))**

| **Food group** | **Consumption in g/day** | | **GHG emissions in kg CO2e** (no land use emissions) | | **Based on data sources** |
| --- | --- | --- | --- | --- | --- |
| **males** | **females** | **per kg consumed** | **per capita-year** (weighted by individual foods) |
| **Meats and Fish** | | | | | |
| Beef | 24.2 | 17.2 | 35.4 (fresh) | 267 | 11, 15, 18 |
| Processed beef | 25.1 | 15.6 | 9.8 | 73 | 5, 17, 18 |
| Pork | 9.7 | 21.2 | 7.9 (cooked ham); 9.0 (fresh) | 47 | 11, 15, 17, 18 |
| Processed pork | 34.2 | 20.7 | 10.1 | 101 | 5, 17, 18 |
| Lamb | 7.9 | 5.6 | 31.9 (grilled); 32.5 (fresh) | 79 | 11, 17, 18 |
| Other red meat | 0.8 | 0.2 | 33.9 (mean beef & lamb) | 6.2 |  |
| White meat | 37.2 | 30.1 | 6.3 (fresh); 7.6 (roasted) | 86 | 11, 15, 17, 18 |
| Processed white meat | 0 | 0 | 6.2 | 0 | 17, 18 |
| Fish | 24.3 | 23.4 | 10.6 (fresh); 19.9 (shellfish) 5.8 (fatty); 8.1 (non-fatty) 5.9 (canned); 6.0 (breaded) | 85 | 2, 5, 11, 12, 17 |
| **Dairy and Eggs** | | | | | |
| Milk and milk-products | 194.8 | 182.7 | 2.0 | 138 | 1, 2, 3, 6, 11, 18 |
| Cheese | 16.3 | 12.9 | 18.3 | 97 | 2, 6, 17, 18 |
| Ice cream | 5.1 | 5.1 | 5.0 | 9.3 | 2, 6, 18 |
| Eggs | 20.9 | 17.3 | 4.7 | 33 | 2, 11, 17, 18 |
| **Cereals and Starchy foods** | | | | | |
| Bread | 99 | 69.4 | 1.7 | 53 | 1, 2, 17 |
| Pasta and pizza | 42.7 | 31.9 | 5.6 (pizza only); 1.0 (pasta only) 6.7 (store readymade) | 38 | 2, 3, 8, 17 |
| Rice | 27.1 | 23.4 | 2.5 (1 kg dry rice = 3 kg cooked rice) | 23 | 1, 2, 7, 11 |
| Breakfast cereals | 28.6 | 27 | 1.7 | 18 | 2 |
| Other cereals | 6.7 | 6.4 | 1.7 | 4.2 | 2 |
| Unprocessed potatoes | 73.9 | 98.1 | 1.5 (post-farmgate emissions dominate total estimate) | 49 | 1, 2, 10, 11 |
| Processed potatoes | 24.5 | 18.2 | 2.3 | 18 | 5, 10, 17 |
| **Vegetables and Fruits** | | | | | |
| Vegetables | 84.8 | 88.6 | 2.0 (above ground); 0.9 (root crops) 2.4 (frozen); 4.6 (tinned) 1.9 (mushrooms) 4.4 (readymade & salads/fruit bar) | 67 (weighted by consumption of individual food items) | 1, 2, 3, 5, 7, 17 |
| Beans and Pulses | 14.6 | 12.5 | 1.5 | 7.3 | 1, 2, 5 |
| Tomatoes | 45.4 | 43.1 | 2.8 | 45 | 1, 2, 11, 17 |
| Fruits | 91.7 | 102 | 1.4 (fresh); 1.9 (tinned) | 51 (weighted by consumption of individual food items) | 1, 2, 5, 17 |
| **Fats and Oils** | | | | | |
| Butter | 3.7 | 3.6 | 31.2 (literature range: 11 to 34.3, up to retailer and excluding waste) | 42 | 6, 8, 17, 18, 19 |
| Margarine and low-fat spread | 9.3 | 6.3 | 20.9 | 60 | 6, 11, 17, 18, 19 |
| Cooking oil | 0.3 | 0.2 | 2.7 | 0.2 | 1, 5, 13, 17 |

| **Food group** | **Consumption in g/day** | | **GHG emissions in kg CO2e** (no land use emissions) | | **Based on data sources** |
| --- | --- | --- | --- | --- | --- |
| **males** | **females** | **per kg consumed** | **per capita-year** (weighted by individual foods) |
| **Sweet and Sugary foods** | | | | | |
| Biscuits | 13.6 | 13.3 | 2.4 | 12 | 2 |
| Buns and cakes | 18.5 | 16.2 | 2.6 | 17 | 2, 5, 17 |
| Chocolate and sweets | 9.9 | 8.8 | 2.9 | 10 | 2 |
| Sugar and sweet spreads | 10.7 | 5.9 | 1.7 | 5.3 | 2, 4 |
| Pudding and pies | 19.1 | 14.2 | 3.2 | 20 | 2, 17 |
| **Savoury snacks** | | | | | |
| Crisps and savoury snacks | 7.2 | 5.6 | 4.6 | 11 | 2, 14, 17 |
| Soups | 36.8 | 36.1 | 4.6 | 62 | 2 |
| Preserves | 27.6 | 24.3 | 3.5 | 33 | 2 |
| **Soft and Alcoholic drinks and other beverages** | | | | | |
| Soft drinks | 246.3 | 187 | 2.0 | 158 | 2 |
| Fruit juice | 62 | 46.9 | 2.4 | 48 | 2 |
| Alcoholic drinks | 426.4 | 117.8 | 1.5 | 148 | 2 |
| Coffee | 265.4 | 246.5 | 0.6 (12g coffee per 180g cup) | 56 | 1 |
| Mineral water | 66.2 | 81.4 | 0.5 (< 0.001 tap water) | 13 | 2, 17 |
| Tea | 406.8 | 445.6 | 0.03 (5 g tea per 180g cup) | 4.2 | 1 |
| **Nuts and Seeds** | | | | | |
| Nuts and seeds | 2.9 | 2.2 | 2.1 | 2.0 | 1, 2, 11, 17 |

**Table S1 Footnotes**

*Lifecycle emissions*. Most literature studies report GHG emissions of food products up to the farm gate or up to the retailer or distribution center (point of sale). Emission factors assume conventional farming practices. Audsley et al., 2009 report emissions up to the wholesaler and, to a lesser degree of detail, also provide aggregate information on the remaining lifecycle stages of food production. In the present work, information from many literature sources (see list below) has been compiled to extend the emissions from the farmgate or retail outlet all the way to final waste disposal ("cradle-to-grave"). Generally speaking, emissions from retailer to final waste disposal (includes emissions from driving to the store and back home, food preparation and cooking, refrigeration and food disposal) account for 20% of the total, 15% if no refrigeration is required, 9% for travel and refrigeration only, and 5% if only travel is involved. Emission factors apply to food groups as a whole, and may vary considerably among individual food items. For a specific food group, the annual emissions per capita are weighted according to dietary intake of individual foods.

*Food losses*. Food losses from production/handling/sales, from cooking meals and "consumer waste", specifically, plate waste and spoilage losses are included. Information from Venkat 2011 was used to estimate post-retailer food losses (incl. plate waste, spoilage and cooking losses, collectively "Consumer waste"). The following loss factors have been applied: 31% for Beef, 35% for Lamb, 37% for Pork, 38% for poultry (usually, a bit higher for Turkey compared to Chicken), 31% for misc. meats, 26% for Fish, 13% for Cheeses, 18% for Milk and Milk products (e.g., Yogurt), 16% for other dairy, 18% for Grains, 14% for Butter/Fats/Oils, 24% for Eggs, 28% for Fruits, 29% for Green Vegetables, 9% for Root Crops and Legumes, and 9% for Nuts. For other commodities, food losses are considered negligible (< 5%). Based on US experience, the consumer accounts for about two-thirds of total food loss (production − consumption), which includes unavoidable (e.g., moisture loss during cooking) and avoidable losses (e.g., spoilage). The avoidable portion is 75%. Retail losses make up most the remaining food losses.

*Uncertainty*. Final results are presented as kg of CO2e emitted per kg of consumed food (edible food portion multiplied by its loss factor). For a representative food item, a range of GHG factors may be found in the literature (see the list in Vieux 2012, for example). Variability depends on numerous factors including methodological approach, choice of system boundaries and input data, and case and site specific considerations (e.g., foods produced locally vs. imported, organic vs. conventional farming methods, fresh vs. processed foods, choice of energy supply (fossil fuels vs. renewable energy), and so forth). For the same food item, emission factors could vary by as much as an order of magnitude. The data presented in Vieux 2012 indicate a high-to-low estimate ratio of 2 with an assumed lognormal distribution (geometric standard deviation of 1.2). The 95% confidence interval of the emissions is therefore obtained by dividing and multiplying the central estimates (geometric mean) by 1.5.

**Table S1 Data sources**

[1] Audsley, E., M. Brander, J. Chatterton, D. Murphy-Bokern, C. Webster and A. Williams. 2009. *How Low Can We Go? An Assessment of Greenhouse Gas Emissions from the UK food System and the Scope to Reduce them by 2050*. FCRN-WWF-UK.

[2] Berners-Lee, M., C. Hoolohan, H. Cammack and C.N. Hewitt. 2012. The Relative Greenhouse Gas Impacts of Realistic Dietary Choices. *Energy Policy*, **43**:184-190.

[3] Carlsson-Kanyama, A. and A.D. Gonzalez. 2009. Potential Contributions of Food Consumption Patterns to Climate Change. *The American Journal of Clinical Nutrition*, **89**:1S-6S.

[4] de Figueiredo, E.B., A.R. Panosso, R. Romao and N. La Scala, Jr. 2010. Greenhouse Gas Emission Associated with Sugar Production in Southern Brazil. *Carbon Balance and Management*, **5**:3 (7 pages).

[5] Encuesta Nacional de Ingesta Dietetica Espagnola (ENIDE) 2011. Agencia Espagnola de Seguridad Alimentaria y Nutrition (AESAN), Gobierno de Espagna, Ministerio de Sanidad, Politica Social E Igualdad. Web-links: <http://www.aesan.msc.es/AESAN/web/notas_prensa/presentacion_enide.shtml> and <http://www.aesan.msc.es/AESAN/docs/docs/evaluacion_riesgos/datos_consumo/ENIDE.pdf>.

[6] Food and Agriculture Organization of the United Nations (FAO). 2010. *Greenhouse Gas Emissions from the Dairy Sector*. Available at: <http://www.fao.org/docrep/012/k7930e/k7930e00.pdf>

[7] Foster, C. K. Green, M. Bleda, P. Dewick, B. Evans, A. Flynn and J. Mylan. 2006. *Environmental Impacts of Food Production and Consumption*. Final report to the Department for Environment Food and Rural Affairs (DEFRA) by Manchester Business School. December 2006.

[8] Fritsche, U.R. and U. Eberle. 2009. *Greenhouse Gas Emissions from the Production and Processing of Food*. Institute for Applied Ecology Working Paper, Darmstadt, Germany.

[9] Garnett, T. 2011. Where Are the Best Opportunities for Reducing Greenhouse Gas Emissions in the Food System (including the food chain)? *Food Policy*, **36**:S23-S32.

[10] Garnett, T. 2006. *Fruit and Vegetables & UK Greenhouse Gas Emissions: Exploring the Relationship*. Food Climate Research Network (FCRN) working paper 06-01 Rev A (September 2006).

[11] Hamerschlag, K. and K. Venkat. 2011. *Meat Eater's Guide to Climate Change and Health: Lifecycle Assessments - Methodology and Results*. Environmental Working Group, Washington D.C. Available at: <http://www.ewg.org/meateatersguide/a-meat-eaters-guide-to-climate-change-health-what-you-eat-matters/>.

[12] Iribarren, D., I. Vazquez-Rowe, A. Hospido, M.T. Moreira and G. Feijoo. 2011. Updating the Carbon Footprint of the Galician Fishing Activity (NW Spain). *Science of the Total Environment*, **409**:1609-1611.

[13] Michalopoulos, G., L. Christodoulopoulou, G. Giakoumaki, C. Manolaraki, S. Malliaraki, K. Aggelaki, E. Zontanou. 2011. *Life Cycle Assessment of Extra Virgin Olive Oil Produced by Three Groups of Farmers in South Greece*. Available at:

<http://www.rodaxagro.gr/main/downloads/en/lca_oil_in_greece_summary.pdf>.

[14] Nilsson, K. V. Sund and B. Floren. 2011. *The Environmental Impact of the Consumption of Sweets, Crisps and Soft Drinks*. Report to the Swedish Food Administration by The Swedish Institute for Food and Biotechnology. ISBN 978-92-893-2197-6.

[15] Sonesson, U., J. Davis and F. Ziegler. 2010. *Food Production and Emissions of Greenhouse Gases: An Overview of the Climate Impact of Different Product Groups*. The Swedish Institute for Food and Biotechnology (SIK), Report No.802.

[16] Venkat, K. 2011. The Climate Change and Economic Impacts of Food Waste in the United States. *International Journal on Food System Dynamics*, **2**(4):431-446.

[17] Vieux, F., N. Darmon, D. Touazi and L.G. Soler. 2012. Greenhouse Gas Emissions of Self-Selected Individual Diets in France: Changing the Diet Structure or Consuming Less? *Ecological Economics*, **75**:91-101.

[18] Weiss, F. and A. Leip. 2012. Greenhouse Gas Emissions from the EU Livestock Sector: A Life Cycle Assessment Carried out with the CAPRI Model. *Agriculture, Ecosystems and Environment*, **149**:124-134.

[19] Hu, M., G.Wong, A. Yu. 2007. *A Life-Cycle and Economics Analysis: Butter vs. Margarine Used in UBC Food Service*. The University of British Columbia, Dept. of Chemical and Biological Engineering, Vancouver, B.C. Canada. April 2007.

**Table S3. Expenditure shares and own-price elasticities of food groups used in optimisation models**

|  |  |  |
| --- | --- | --- |
| Food Group / Nutrient | Expenditure share 2009 | Own-price elasticity 2009 |
| Beef | 71 = 0.027 | -0.594 |
| Processed beef | 181 = 0.068 | -0.97 |
| Pork | 28 = 0.011 | -0.779 |
| Processed pork | 120 = 0.045 | -0.723 |
| Lamb | 35 = 0.013 | -0.551 |
| Other red meat | 19 = 0.007 | -0.843 |
| Poultry | 111 = 0.042 | -0.9 |
| Processed white meat | 1 = 0.000 | -0.9 |
| Fish | 117 = 0.044 | -0.743 |
| Milk and milk products | 200 = 0.075 | -0.827 |
| Cheese | 75 = 0.028 | -0.65 |
| Ice cream | 22 = 0.008 | -0.669 |
| Eggs | 27 = 0.01 | -0.664 |
| Bread | 118 = 0.044 | -0.798 |
| Pasta and pizza | 66 = 0.025 | -0.798 |
| Breakfast cereals | 43 = 0.016 | -0.798 |
| Rice | 29 = 0.011 | -0.798 |
| Other cereals | 6 = 0.002 | -0.798 |
| Unprocessed potatoes | 36 = 0.014 | -0.319 |
| Processed potatoes | 74 = 0.028 | -0.319 |
| Other vegetables | 173 = 0.065 | -1.01 |
| Beans and pulses | 17 = 0.006 | -0.764 |
| Tomatoes | 28 = 0.011 | -0.703 |
| Fruit | 168 = 0.063 | -0.982 |
| Butter | 15 = 0.006 | -0.624 |
| Margarine and low fat spread | 18 = 0.007 | -0.624 |
| Cooking oil | 11 = 0.004 | -0.624 |
| Biscuits | 66 = 0.025 | -0.575 |
| Buns and cakes | 64 = 0.024 | -0.575 |
| Chocolate and sweets | 93 = 0.035 | -0.575 |
| Sugar and sweet spreads | 13 = 0.005 | -0.575 |
| Crisps and savoury snacks | 35 = 0.013 | -0.624 |
| Puddings and pies | 17 = 0.006 | -0.575 |
| Soups | 16 = 0.006 | -0.665 |
| Preserves | 6 = 0.002 | -0.575 |
| Soft drinks | 85 = 0.032 | -0.749 |
| Alcoholic drinks | 289 = 0.11 | -0.786 |
| Fruit juice | 32 = 0.012 | -0.808 |
| Coffee | 26 = 0.01 | -0.749 |
| Mineral water | 9 = 0.003 | -0.749 |
| Tea | 18 = 0.007 | -0.749 |
| Nuts and seeds | 16 = 0.006 | -0.767 |

Note: Data on expenditure shares are taken from the 2009 National Diet and Nutrition Survey, and data on own-price elasticities are taken from Tiffin *et al* Estimating Food and Drink Elasticities (2011).

**Table S4a. Complete data on food groups consumed per day in optimised diets for adult men in the UK**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Food consumption in grams** | | | | | | | | |
| **Food Group** | **Current Diet** | **Nutritionally optimised diet** | **Optimised diet with 10% emissions reduction** | **Optimised diet with 20% emissions reduction** | **Optimised diet with 30% emissions reduction** | **Optimised diet with 40% emissions reduction** | **Optimised diet with 50% emission reduction** | **Optimised diet with 60% emissions reduction** | **Optimised diet with 70% emissions reduction** |
| **Beef** | 24.2 | 13.8 | 14.0 | 13.6 | 5.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Processed beef** | 25.1 | 18.2 | 18.2 | 18.7 | 17.7 | 16.3 | 3.3 | 0.0 | 0.0 |
| **Pork** | 9.7 | 6.0 | 6.0 | 4.5 | 5.5 | 6.6 | 0.0 | 0.0 | 0.0 |
| **Processed pork** | 34.2 | 3.7 | 3.0 | 4.4 | 3.9 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Lamb** | 7.9 | 5.8 | 5.7 | 6.6 | 4.3 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other red meat** | 0.8 | 0.8 | 0.7 | 0.7 | 0.6 | 0.4 | 0.0 | 0.0 | 0.0 |
| **Poultry** | 37.2 | 23.3 | 23.2 | 23.5 | 26.8 | 24.9 | 1.2 | 2.7 | 0.0 |
| **Processed white meat** | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Fish** | 24.3 | 30.0 | 30.2 | 28.5 | 29.2 | 25.4 | 20.9 | 0.0 | 0.0 |
| **Milk and milk products** | 194.8 | 114.0 | 125.6 | 117.0 | 108.1 | 58.7 | 6.5 | 0.0 | 0.0 |
| **Cheese** | 16.3 | 2.6 | 3.4 | 2.0 | 2.6 | 3.4 | 0.0 | 0.0 | 0.0 |
| **Ice cream** | 5.1 | 4.2 | 4.1 | 4.6 | 4.2 | 4.0 | 1.4 | 0.0 | 0.0 |
| **Eggs** | 20.9 | 4.8 | 3.8 | 4.7 | 10.1 | 20.5 | 15.6 | 3.5 | 0.0 |
| **Bread** | 99 | 145.4 | 145.8 | 145.6 | 142.7 | 146.1 | 154.9 | 147.9 | 0.0 |
| **Pasta and pizza** | 42.7 | 45.7 | 45.6 | 46.6 | 47.2 | 49.7 | 49.5 | 40.8 | 0.0 |
| **Breakfast cereals** | 28.6 | 39.5 | 37.3 | 39.7 | 40.3 | 42.3 | 61.8 | 97.8 | 255.5 |
| **Rice** | 27.1 | 51.1 | 51.3 | 51.4 | 48.2 | 33.1 | 35.5 | 5.6 | 0.0 |
| **Other cereals** | 6.7 | 14.4 | 13.8 | 14.6 | 15.4 | 19.2 | 29.3 | 43.8 | 0.0 |
| **Unprocessed potatoes** | 73.9 | 123.0 | 121.4 | 122.6 | 121.0 | 115.9 | 118.7 | 87.3 | 0.0 |
| **Processed potatoes** | 24.5 | 31.8 | 33.5 | 32.6 | 32.9 | 31.2 | 36.7 | 41.5 | 0.0 |
| **Other vegetables** | 84.8 | 132.4 | 132.0 | 131.9 | 134.0 | 140.7 | 146.0 | 164.7 | 0.0 |
| **Beans and pulses** | 14.6 | 20.3 | 21.9 | 21.6 | 21.7 | 26.8 | 32.3 | 61.6 | 400.0 |
| **Tomatoes** | 45.4 | 90.6 | 90.6 | 90.4 | 87.7 | 74.5 | 49.9 | 0.0 | 0.0 |
| **Fruit** | 91.7 | 156.7 | 155.4 | 156.1 | 156.6 | 158.0 | 171.7 | 173.7 | 0.0 |
| **Butter** | 3.7 | 1.0 | 0.0 | 1.3 | 1.6 | 1.4 | 0.0 | 0.0 | 0.0 |
| **Margarine and low fat spread** | 9.3 | 21.8 | 21.7 | 22.0 | 20.9 | 16.4 | 13.3 | 0.0 | 0.0 |
| **Cooking oil** | 0.3 | 0.3 | 0.4 | 0.3 | 0.3 | 0.4 | 0.5 | 0.9 | 69.4 |
| **Biscuits** | 13.6 | 14.1 | 16.0 | 13.4 | 14.8 | 18.7 | 21.9 | 23.1 | 0.0 |
| **Buns and cakes** | 18.5 | 20.1 | 18.4 | 19.2 | 21.5 | 26.4 | 32.2 | 37.9 | 0.0 |
| **Chocolate and sweets** | 9.9 | 8.6 | 9.0 | 9.3 | 9.4 | 10.8 | 10.8 | 11.6 | 0.0 |
| **Sugar and sweet spreads** | 10.7 | 7.1 | 8.4 | 7.4 | 9.2 | 11.9 | 9.3 | 1.7 | 35.3 |
| **Crisps and savoury snacks** | 7.2 | 7.2 | 7.6 | 6.3 | 7.5 | 9.9 | 13.1 | 13.8 | 0.0 |
| **Puddings and pies** | 19.1 | 12.6 | 12.2 | 12.8 | 16.5 | 21.2 | 12.0 | 0.0 | 0.0 |
| **Soups** | 36.8 | 0.9 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Preserves** | 27.6 | 2.6 | 1.8 | 4.7 | 3.2 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Soft drinks** | 246.3 | 65.9 | 55.0 | 42.6 | 21.7 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Alcoholic drinks** | 426.4 | 426.4 | 426.4 | 426.4 | 426.4 | 426.4 | 426.4 | 426.4 | 426.4 |
| **Fruit juice** | 62 | 50.1 | 45.2 | 41.2 | 29.4 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Coffee** | 265.4 | 25.9 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 |
| **Mineral water** | 66.2 | 102.1 | 1.7 | 1.2 | 1.6 | 6.2 | 0.0 | 0.0 | 0.0 |
| **Tea** | 406.8 | 802.7 | 944.8 | 961.7 | 994.0 | 1,039.7 | 1,046.7 | 1,046.7 | 1,046.7 |
| **Nuts and seeds** | 2.9 | 5.7 | 5.9 | 6.0 | 5.5 | 8.5 | 12.4 | 30.4 | 0.0 |

**Table S4b. Complete data on food groups consumed per day in optimised diets for adult women in the UK**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Food consumption in grams** | | | | | | | | |
| **Food Group** | **Current Diet** | **Optimised diet with 0% emissions reduction** | **Optimised diet with 10% emissions reduction** | **Optimised diet with 20% emissions reduction** | **Optimised diet with 30% emissions reduction** | **Optimised diet with 40% emissions reduction** | **Optimised diet with 50% emission reduction** | **Optimised diet with 60% emissions reduction** | **Optimised diet with 70% emissions reduction** |
| **Beef** | 17.2 | 13.9 | 14.4 | 7.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Processed beef** | 15.6 | 14.2 | 16.1 | 14.9 | 13.4 | 11.8 | 7.8 | 0.0 | 0.0 |
| **Pork** | 5.3 | 5.0 | 5.1 | 5.1 | 4.4 | 3.4 | 1.1 | 0.0 | 0.0 |
| **Processed pork** | 20.7 | 19.0 | 16.4 | 15.6 | 16.9 | 13.0 | 5.3 | 0.0 | 0.0 |
| **Lamb** | 5.6 | 4.8 | 5.2 | 3.7 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other red meat** | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.1 | 0.0 | 0.0 |
| **Poultry** | 30.1 | 30.2 | 29.9 | 28.6 | 25.1 | 14.9 | 0.0 | 0.0 | 0.0 |
| **Processed white meat** | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Fish** | 23.4 | 26.8 | 27.8 | 26.7 | 25.9 | 23.2 | 16.4 | 1.6 | 0.0 |
| **Milk and milk products** | 182.7 | 113.2 | 125.6 | 115.2 | 112.2 | 69.6 | 0.0 | 0.0 | 0.0 |
| **Cheese** | 12.9 | 6.5 | 4.8 | 6.7 | 7.0 | 2.8 | 0.0 | 0.0 | 0.0 |
| **Ice cream** | 5.1 | 3.8 | 3.6 | 4.2 | 4.3 | 4.3 | 2.9 | 0.0 | 0.0 |
| **Eggs** | 17.3 | 12.7 | 12.4 | 14.7 | 15.5 | 15.2 | 10.3 | 0.0 | 0.0 |
| **Bread** | 69.4 | 92.4 | 92.7 | 95.3 | 96.7 | 112.1 | 131.9 | 133.6 | 0.0 |
| **Pasta and pizza** | 31.9 | 31.9 | 31.7 | 33.0 | 32.7 | 34.1 | 31.2 | 19.9 | 0.0 |
| **Breakfast cereals** | 27 | 32.0 | 31.3 | 31.7 | 32.4 | 41.0 | 48.6 | 68.8 | 181.9 |
| **Rice** | 23.4 | 29.3 | 29.2 | 26.7 | 24.8 | 23.7 | 14.6 | 0.0 | 0.0 |
| **Other cereals** | 6.4 | 8.7 | 8.3 | 9.4 | 12.4 | 17.0 | 23.5 | 40.1 | 107.9 |
| **Unprocessed potatoes** | 98.1 | 122.1 | 120.7 | 119.8 | 119.2 | 115.4 | 122.0 | 68.3 | 0.0 |
| **Processed potatoes** | 18.2 | 19.8 | 17.9 | 20.0 | 20.7 | 21.6 | 23.5 | 29.6 | 0.0 |
| **Other vegetables** | 88.6 | 137.7 | 139.6 | 136.0 | 144.8 | 150.7 | 153.7 | 156.2 | 0.0 |
| **Beans and pulses** | 12.5 | 20.4 | 20.5 | 21.7 | 24.0 | 26.6 | 32.2 | 53.5 | 339.9 |
| **Tomatoes** | 43.1 | 83.7 | 82.8 | 82.7 | 72.9 | 61.3 | 42.2 | 28.2 | 0.0 |
| **Fruit** | 102 | 158.2 | 157.2 | 159.5 | 158.3 | 161.4 | 171.8 | 162.1 | 60.1 |
| **Butter** | 3.6 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Margarine and low fat spread** | 6.3 | 11.9 | 12.2 | 11.5 | 10.4 | 9.2 | 8.9 | 3.3 | 0.0 |
| **Cooking oil** | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.3 | 0.4 | 2.1 |
| **Biscuits** | 13.3 | 11.5 | 12.7 | 12.6 | 15.1 | 17.8 | 20.3 | 27.2 | 1.3 |
| **Buns and cakes** | 16.2 | 15.0 | 14.8 | 18.4 | 19.2 | 22.5 | 26.5 | 36.6 | 0.0 |
| **Chocolate and sweets** | 8.8 | 7.7 | 7.8 | 8.3 | 8.6 | 9.4 | 10.2 | 6.9 | 0.0 |
| **Sugar and sweet spreads** | 5.9 | 4.8 | 5.0 | 5.8 | 6.3 | 8.0 | 9.5 | 5.4 | 0.0 |
| **Crisps and savoury snacks** | 5.6 | 5.6 | 5.8 | 5.7 | 6.6 | 7.4 | 8.8 | 13.0 | 0.0 |
| **Puddings and pies** | 14.2 | 11.2 | 10.9 | 12.4 | 12.8 | 12.0 | 7.5 | 0.0 | 0.0 |
| **Soups** | 36.1 | 36.1 | 35.8 | 20.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Preserves** | 24.3 | 6.5 | 5.7 | 6.3 | 6.2 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Soft drinks** | 187 | 61.2 | 60.2 | 31.0 | 21.4 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Alcoholic drinks** | 117.8 | 117.8 | 117.8 | 117.8 | 117.8 | 117.8 | 117.8 | 117.8 | 117.8 |
| **Fruit juice** | 46.9 | 37.6 | 37.6 | 28.7 | 21.3 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Coffee** | 246.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Mineral water** | 81.4 | 0.0 | 0.0 | 0.0 | 0.1 | 1.5 | 0.0 | 0.0 | 0.0 |
| **Tea** | 445.6 | 908.7 | 909.6 | 947.7 | 964.6 | 1,005.9 | 1,007.4 | 1,007.4 | 1,007.4 |
| **Nuts and seeds** | 2.2 | 3.2 | 3.2 | 3.5 | 4.0 | 5.0 | 6.9 | 14.3 | 70.8 |

**Text S1. Weights used in dietary optimisation models**

The diet stipulates a minimum (or maximum) consumption of certain broad food categories (or properties of those categories) according to WHO nutritional recommendations. These limitations in turn will result in consumption levels of specific foods that differ from those the individual would have chosen given the prices of those foods and the individual’s income. The welfare loss in case of consumption below the desired amount is shown in Figure S1a and the loss in case of consumption above the desired amount is shown in Figure S1b.

**Figure S1a. Welfare Loss from Desired Consumption > WHO Recommended Consumption**

Price (P)

Quantity (X)

WHO Recommended

Consumption

Desired

Consumption

Loss of Welfare

**Figure S1b. Welfare Loss from Desired Consumption < WHO Recommended Consumption**

Price (P)

Quantity (X)

WHO Recommended

Consumption

Desired

Consumption

Loss of Welfare

The loss in welfare in either case can be written as ΔW, where:

We can use the expression for the price elasticity, which we define as ε to rewrite the expression as:

Where:

Rearranging terms we get:

Where M is total income and PX/M is the share of expenditure devoted to this good. We can represent it by the letter ‘s’. The above equation indicates that the loss of welfare is proportional to the share s and inversely proportional to the price elasticity of demand:

This analysis proposes therefore that the programming should seek to find the combination of goods that minimizes the weighted deviations of squared percentage consumption from the desired levels, where each deviation is weighted by s/ε.

The above analysis is simplified because the shift in consumption to the WHO level can involve changes in other goods and services and these are not taken into account. In such a case the change in welfare has to allow for the secondary effects of these changes and the simple proportionality to the own price elasticity does not hold. However, the above is a first approximation to the change in welfare and provides a reasonable guide to the weight that should be attached to each shift in diet on health grounds when calculating the perceived personal welfare loss of that shift.