Designing a healthy and sustainable diet

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Abstract

Many Western countries such as Scotland face the challenge of reducing carbon emissions associated with food systems (Garnett 2011) while also improving dietary nutritional intake (Scottish Government 2016). Both measures together with affordability represent a sustainable diet. The purpose of this paper is to estimate a healthy and sustainable diet for the major demographic groups in Scotland through producing a list of food products which would help create such a diet. The data for the analysis were sourced from the National Diet and Nutrition Survey (NDNS) for the purposes of estimating Scottish food consumption categories and their respective nutrients. The datasets were augmented with prices obtained from 2014 Kantar Worldpanel data in addition to carbon footprint data (cradle to grave). The diet was designed using a linear programming model, which minimised the monetary cost of the diet subject to 22 nutritional constraints based on UK and Scottish dietary recommendations plus a greenhouse gas emission constraint. The results suggest that a sustainable and healthy diet is possible for all the demographic groups. All 22 nutrient constraints were satisfied in the modelling of the healthy and sustainable diet and the cost of the seven-day diet was estimated to be the most expensive for the Female 11-14 group at £18.20. However, the diets are virtually vegetarian based and some quantities of food products are unrealistic, which may pose issues for consumer acceptability.

Keywords [Food Consumption, Linear Programming, Nutrition, Sustainability]

JEL code [D120, C020, I100, Q560]

1. Introduction

Many Western countries such as Scotland face the challenge of reducing carbon emissions (i.e. greenhouse gas GHG emissions) associated with food systems (Garnett 2011) while also improving dietary nutritional intake (Scottish Government 2016). Therefore, designing a diet which fulfils the aforementioned issues is crucial with regards to the issue of sustainability.

The definition of a sustainable diet as agreed at the 2010 Food and Agriculture Organization (FAO) International Scientific Symposium on Biodiversity and Sustainable Diets is: "*diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources."* (FAO 2012). A recent systematic literature review found that out of 113 peer reviewed papers studying sustainable diets, 71 papers measured GHG emissions whilst only 13 papers measured the associated monetary cost of such a diet (Jones et al. 2016). Therefore, the area of monetary cost of a sustainable diet is often ignored in favour of mainly GHG emissions.

This study will model a sustainable diet (referred to as a healthy and sustainable diet) based on the following three components: low in greenhouse gas emissions (GHG), fulfils the various government dietary recommended values (DRVs) and has a low monetary cost for consumers. This study estimates a healthy and sustainable diet for the major demographic groups in Scotland and produces a list of the relevant food products in order to achieve such a diet.

Many studies in agricultural economics such as Edjabou and Smed (2013), Caillavet et al (2016) and Kehlbacher et al (2016) have estimated the effects of price based policies on nutrient intake and carbon emissions through the fiscal measures of consumption taxes. However, these studies often lack detail on the exact quantities of food products which would form a healthy sustainable diet and understanding this would likely improve research in this area. The issue surrounding recent studies using linear programming (LP) are the lack of nutrient constraints in addition to failing to incorporate both price and GHG emissions into the model (Macdiarmid et al. 2012). Or only a small set of possible food products being used in the LP (Wilson et al. 2013).

The structure of the paper is as follows: The literature review highlights recent studies using LP. The Data section presents a description of the data required for the estimation of the LP. The methods section details how the LP was estimated along with the seven-day diet. The Results and Discussions section details the estimates of the LP.

2. Literature review

Macdiarmid et al (2011) used a linear programme with the objective function of minimising carbon emissions subject to the various dietary constraints for estimating a diet called "Livewell 2020" through the use of upper and lower limits of certain food products. The study found that the UK diet contained 7.14 kgCO2e/adult/day and estimated that the emissions associated with the "livewell" diet were 4.32 kgCO2e/woman/day (Macdiarmid et al. 2011). Macdiarmid et al (2011) estimated a weekly list of food products which could then be turned into recipes for different meals. The paper also estimated the monetary costs of this "Livewell 2020 diet" at £28.40 per person per week, which the authors attribute to helping with "consumer acceptability" (Macdiarmid et al. 2011).

More recent UK based sustainable diets were estimated by Macdiarmid et al (2012) which used 13 nutrient constraints in addition to some food constraints. The dietary constraints of a female aged 19-50 were based on Department of Health's Committee on Medical Aspects (COMA) 1991 report. This report does provide a more comprehensive list of dietary reference values (DRVs) for the UK (COMA 1991) than just the 13 constraints. The results suggest that a 36 percent reduction in GHG emissions (relative to 1990 baseline diet) for a female diet is possible with acceptability constraints and an even larger reduction of 90 percent is possible though the resulting diet is unlikely to be acceptable to consumers (Macdiarmid et al. 2012). Macdiarmid et al (2012) estimated the lowest possible GHG emissions diet of 2.43 kg CO_2e/day with the GHG emission data being adjusted by the authors to partially account for some of the consumer stages e.g. hydration of rice involved in cooking.

Macdiarmid et al (2012) estimated the lowest possible GHG emissions diet through LP modelling with "acceptability" constraints. The acceptability constraints involved placing upper and lower constraints which were formed from food products which were consumed from at least 50 percent of the NDNS sample (Macdiarmid et al. 2012). This is an improvement relative to the other studies though it does mean that the list of total food products entered into

the LP is likely reduced. It may be the case that some demographic groups have particular preferences, which would be ignored through this method.

While acceptability is an important area, it does seem that understanding the underlying consumer preferences would provide for an idea of food substitutes for which these authors do not include. The study included the use of inserting milk as a minimum requirement in order to have cereal and milk (in addition to add to hot drinks) as the LP returned cereal without milk (Macdiarmid et al. 2012). Macdiarmid et al (2012) explain that reducing milk below certain levels would pose a problem with the cereal component of the diet. However, some milk products do have a relatively low carbon footprint and it is possible that the study's use of attaching a carbon footprint to the food groups instead of individual products may have masked this potential result.

Wilson et al (2013) used LP in order to model different scenarios involving both cost and emissions with regards to New Zealand through modelling DRVs of males only. Wilson et al (2013) used data covering 76 food items and GHG emissions data which from the description likely covers cradle to regional distribution centre. The price data were obtained from the New Zealand Food Price Index (FPI) and online supermarkets (Wilson et al. 2013). The study involved four scenarios whereby cost was minimised, four scenarios where emissions were minimised and finally Asian and Mediterranean diets. The results suggest all the scenarios would result in more nutritious diets (relative to NZ existing diets) and were less costly than the existing NZ diet (Wilson et al. 2013). However, this study includes a limited range of food items and the use of separate cost and emission scenarios appears to limit the ability of the diet to be both low monetary cost and low emissions. There is also little attempt to extend the resulting diet to a weekly basis such as in Macdiarmid et al (2012).

Horgan et al (2016) used linear programming in order to understand how individual diets from the National Diet and Nutrition Survey (NDNS) sample could be changed in order to create a healthier and lower GHG diet. The paper found that diverse changes in diet could result in a healthy and sustainable diet. Horgan et al (2016) used four different steps in order to increase their sample (from the NDNS) which adheres to a sustainable and healthy diet based on four different steps: "1. No change to the foods being eaten, only the quantity", "2. Changes to the amount of any food already being eaten and addition of new foods", "3. Greater reduction in the amount of any food already eaten and new foods added" and "4. Removal of any food from

the current diet". This is particularly interesting result which demonstrates the challenge of healthy diets (not even sustainable) is that only one person out of the 1,491 sample met all the constraints. Horgan et al (2016) did not consider the cost of this healthy and sustainable diet.

3. Empirical work

3.1 Data

The data consisted of using the National Diet and Nutrition Survey (NDNS) for the purposes of estimating the available food products and their respective nutrient content. Median unit prices of food products were obtained from the Scottish section of the 2014 Kantar Worldpanel data and matched to the NDNS data. Cradle to grave carbon footprint data were matched to the NDNS data. The constraints consisted of 22 dietary reference values (DRVs) which were obtained from the Department of Health's Committee on Medical Aspects[1] report in addition to the updated Scottish Dietary Goals (Scottish Government 2016).

National Diet and Nutrition Survey (NDNS)

The NDNS "year 4 databank" (covering 2008 to 2012) was used for this study as it contains nutrient data for a variety of food products (NatCen Social Research, MRC Human Nutrition Research & University College London 2015). This dataset contains 4,379 records on food, drink and supplements. However, as products such as baby foods, alcohol and supplements were not required the dataset was reduced to 4,405 records. There were also cases where products in the NDNS dataset could not be found in the Kantar dataset such for specific branded products or particular food products.

Dietary recommended values

The DRVs are based mainly on the reference nutrient intakes (RNI) and revised Scottish dietary goals (SDG). The RNI is the amount of nutrient which satisfies the requirement of at least 97 percent of a group (Eastwood 1997). The Scottish Dietary Goals (SDG) cover additional nutrients relative to the RNIs (Scottish Government 2016). This study focusses on the nutrients listed in Table 1 which form the constraints for the linear programme. One of the recent revisions made to the SDG is that dietary fibre intake should increase for adults to 30g/day (Scottish Government 2016). It is important to highlight the NDNS dataset records Englyst

[1] Referred to as reference nutrient intake (RNI)

(NSP) fibre which is different from the AOAC fibre of SDG. Lockyer et al (2016) provide the conversion factor for the different fibres.

Table 1 Dietary recommended values for the different demographic groups

	Child 7-10	Female 11-14	Male 11-14	Female 15-18	Male 15-18	Female 19-50	Male 19-50	Female 50 plus	Male 50 Plus
Energy (Kj)	7362.5	9100	9850	10175	12575	8950	11225	8300	10250
Protein (g)	28.3	41.2	42.1	45	55.2	45	55.5	46.50	53.3
Sodium (mg)	1200	1600	1600	1600	1600	1600	1600	1600	1600
Calcium (mg)	550	800	1000	800	1000	700	700	700	700
Magnesium (mg)	200	280	280	300	300	270	300	270	300
Iron (mg)	8.7	14.8	11.3	14.8	11.3	14.8	8.7	8.70	8.7
Copper (mg)	0.7	0.8	0.8	1	1	1.2	1.2	1.20	1.2
Zinc (mg)	7	9	9	7	9.5	7	9.5	7	9.5
Vitamin A (µg)	500	600	700	600	700	600	700	600	700
Thiamin (mg)	0.7	0.7	1.1	0.8	1.1	0.8	1	0.80	0.9
Riboflavin (mg)	1	1.1	0.9	1.1	1.3	1.1	1.3	1.10	1.3
Niacin (mg)	12	12	15	14	18	13	17	12	16
Vitamin B6 (mg)	1	1	1.5	1.2	1.5	1.2	1.4	1.20	1.4
Vitamin B12 (µg)	1	1.2	1.2	1.5	1.5	1.5	1.5	1.50	1.5
Folate (µg)	150	200	200	200	200	200	200	200	200
Vitamin C (mg)	30	35	35	40	40	40	40	40	40
Iodine (µg)	110	130	130	140	140	140	140	140	140
Selenium (µg)	30	45	45	60	70	60	75	60	75
Sugar (g)	20	25	25	30	30	30.00	30	30	30
Fat (g)*	65.96	67.39	73.13	61.16	90.61	59.13	87.92	54.66	81.06
Saturated Fat (g)*	20	20	22.98	19.22	28.48	18.58	27.63	17.18	25.48
Fibre (g)	14.80	15.70	15.70	18.50	18.50	18.50	18.50	18.50	18.50

Source: Based on reference nutrient intakes (RNI) and revised Scottish dietary goals (SDG)

Notes: * indicates that the absolute values for total fat and saturated fat presented were estimated using the Scottish Dietary Goals (Scottish Government 2016) relative fat intake guidelines. These were estimated using NDNS “Person level dietary data”.

Kantar Worldpanel data

In order to obtain unit prices paid by households it was necessary to use the Scottish section of Kantar Worldpanel data. Kantar Worldpanel provided different food groups. 589 of these food groups were individually matched to the NDNS food products with homemade food products being matched to the most similar products in the Kantar database. The median unit price for each category were estimated (adjusted on per 100 gram basis) in order for a more representative price which is not skewed by either low cost or luxury products (e.g. coffee) within a particular category.

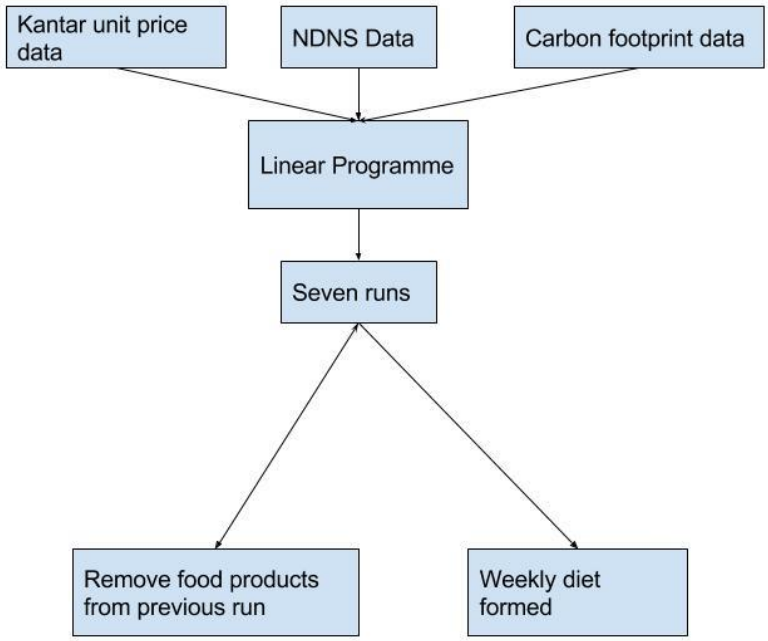
Cradle to grave carbon footprint data

Some studies such as Macdiarmid et al (2012) have estimated diets based on cradle to regional distribution centre (at food group level and not individual products) and then adjusted the values to partially incorporate the end sections of the chain. However, this study has used cradle to grave carbon footprint data in order to estimate a diet which considers the waste stage etc. of the food chain. Most of the carbon footprint (CF) values (main exceptions being tap water and hot beverages) follow the British Standards Institute PAS 2050 cradle to grave method (BSI 2008) in order to ensure greater consistency. In total 116 carbon footprint values were matched to the 4,405 NDNS products.

3.2 Method

Figure 1 shows how the three main datasets are combined for the purposes of estimating the linear programme. The estimation follows an iterative process in the sense that after the first diet is obtained (i.e. Day one), any food product within the diet were removed from the aforementioned dataset. This process was repeated until a seven-day diet was formed and ensures that different food products would be contained within each diet. Diets for the main demographic groups were estimated in order to obtain a resulting diet which closely matches the specific group DRVs.

Figure 1 Overview



Before estimating the linear programme, a restriction was placed on the NDNS data whereby products which contained zero energy were excluded in order to avoid the resulting diets containing unrealistically large quantities of products such as tea or water. A further restriction included excluding all alcoholic beverages as these are not listed in either the COMA or SDG.

The linear programme (LP) were estimated[2] using the objective function to minimise the monetary cost of diet. With regards to equation 1 the objective function (minimise unit costs i.e. price) is made up of: c_1 which is the contribution of food item i to unit cost, x_1 is quantity of food and subscript n represents the food groups. Inequality and equality constraints are shown in 2 to 4 and feature r_j which represents the carbon or nutritional constraints formed from these groups and a_{jn} is the weight of the food group to theses dietary constraints.

$$\underset{x}{Min} \quad \sum_{i=1}^{n} c_i x_i \qquad (1)$$
$$s.t.$$

2 represents the minimum carbon emissions of the diet. The carbon footprint constraints were estimated from running the LP with the objective function minimising the carbon footprint

[2] The LP was estimated using R package "Rglpk" (Theussl et al. 2016)

(removing price) and the resulting emissions were then set as a minimum level constraint of emissions for the diet. The reason that this constraint is set at a minimum level is because initial estimations found that the dietary recommended values required adjustment if the emissions were set as a maximum level and this therefore distorts the purpose of the sustainable healthy diet.

$$\sum_{i=1}^{1} a_i x_i \geq \mathrm{r}_j \qquad (2)$$

3 represents 19 of the DRVs which ensures the resulting diet equates to the exact DRV.

$$\sum_{i=1}^{19} a_i x_i = \mathrm{r}_j \qquad (3)$$

4 represents total fat and saturated fat constraints.

$$\sum_{i=1}^{2} a_i x_i \leq \mathrm{r}_j \qquad (4)$$

It is important to note that each run of the LP was checked for the condition of it being an optimal solution.

4. Results and Discussion

The results suggest that a sustainable and healthy diet is possible for all the demographic groups. All 22 nutrient constraints (in addition to the GHG constraint) were satisfied in the modelling of the healthy sustainable diet. Table 2 shows the resulting carbon emissions associated with the diet and the resulting cost. It should be noted that as some of the quantities modelled, such as herbs are small quantities and a unit price represents these products (given that a jar of herbs could last an individual many weeks). Due to space constraints only day seven diets are listed in the appendix though the full seven-day diets are available from the author.

The GHG emissions of the seven day diets in Table 2 shows a variation from the lowest value of 12.66 Kg CO_2e for children aged 7 to 11 to the highest value of 24.75 Kg CO_2e for males aged 15 to 18. Using Audsley et al (2009) "Annual emissions per capita in regions" it is possible to estimate an approximate reduction in emissions of each Scottish diet. Audsley et al (2009) do emphasise the uncertainties with their data and the following results should be treated with some caution as it is similar but not identical to the carbon footprint data of this study. All the diets would reduce GHG emissions by a large percentage with the children aged 7-11

experiencing the largest reduction of 83.5 percent. The large reduction appears logical given the composition of such diets which will be discussed in the next two paragraphs.

The day one and day seven diets in Table 3 to Table 20 (in the appendix) show a varied list of food products along with the quantity (grams). For some of these diets, food products are listed in very small quantities and this does pose an issue for a realistic diet. However, unlike Macdiarmid et al (2012), milk products feature in many of the days which could be used as a drink or with cereal (for day 7 milk products do not feature to the same extent as previous days). As the only constraints were excluding alcohol and zero energy products then this is an interesting finding which has likely arisen through using more detailed carbon emissions and price data. Unfortunately, it is difficult to estimate an average Scottish NDNS diet at the same level of disaggregation as this study which makes estimating a baseline diet for purposes of nutrient intake and carbon emissions unreliable.

The existence of meat and cheese which are both considered to have high carbon footprints and in most cases high in saturated fat (excluding white meats) made up very low shares of the seven-day diet for each demographic group (as shown in Table 2). All of the diets for the individual demographic groups are virtually meat and cheese free. This does raise the question of consumers adapting to a vegetarian diet. In many of the day one diets "energy drink mix powder maltodextrin based" existed which then limited other sugar based food products (all diets fulfilled their sugar constraint). This product may not be acceptable to many consumer preferences.

The most expensive seven day diet would be for the Female 11-14 group of £18.20 (using 2014 Kantar Worldpanel prices). This is an approximate figure given the earlier explanation with regards to jars of herbs. However, this value is lower than the 2014 UK average weekly food expenditure of £29.57 (nominal expenditure) (Defra 2015). Whilst Macdiarmid et al (2012) created full menus (which this study did not do) which could affect the overall cost to the consumer (likely to increase the cost) and their study found that the resulting diet would cost approximately £29 (in 2010 prices). As Macdiarmid et al (2012) did not use price in the objective function then it does make a direct comparison difficult. As this is one of the first studies to include both GHG emissions and price (sourced from Kantar Worldpanel data) then it seems that healthy sustainable diets are not as expensive as previously modelled.

Table 2 Carbon emissions and costs associated with seven day diet

	Carbon emissions (Kg CO2e)	Reduction in emissions (%)	Cost (£)	Share of meat and cheese (%)
Child 7-10	12.66	83.5	6.98	0.03
Female 11-14	18.64	75.6	18.20	0.04
Male 11-14	18.08	76.4	12.63	0.02
Female 15-18	23.32	69.5	16.60	0
Male 15-18	24.75	67.7	15.69	0.01
Female 19-50	18.82	75.4	10.59	0.01
Male 19-50	24.47	68.0	12.19	0
Female 50 plus	18.74	75.5	11.47	0.07
Male 50 Plus	22.13	71.1	12.19	0.05

Source: Own elaborations

Incorporating consumer acceptability which is based on microeconomic theory would likely improve these results as a healthy and sustainable diet must be a realistic diet from a consumer's preferences in order to increase the likelihood of the actual diet being consumed. The time scale could be adjusted from a seven-day diet to a 14-day diet in order to create a more varied diet. However, this could result in an unrealistic diet in the sense that the resulting food products may be unappetising or the quantities are very small.

5. Conclusions

Designing a healthy and sustainable for Scottish individuals would be possible and could also cost the consumer less than the average UK weekly food expenditure. This highlights how a healthy sustainable diet may also be less expensive for the consumer which is likely because of the lack of meat. The inclusion of 589 prices (in the form of unit price) and 116 carbon footprint values marks an improvement over the previous literature which used food groups rather than individual level matching. Also the inclusion of price and carbon footprint values in the linear programme (LP) allow for improved dietary modelling. This study also modelled the DRVs of the individual groups rather than one demographic DRVs to represent all demographic groups.

However, there are issues with using LP such as the failure to account for consumer acceptability through the incorporation of microeconomic theory. The unrealistic quantities of some food products is also an issue. The main contribution of this study is the improved use of data and linear programming. This study recommends the use of similar disaggregated food data for future work on modelling sustainable diets instead of food group level data.

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Appendix

The following tables show the quantities (Grams) of food products (FOODNAME) which would satisfy the nutritional and GHG emission constraints of the specific demographic groups. The FOODNAME is derived from the NDNS dataset. Due to space constraints it was not possible to show the seven day diet for each demographic group thus only day one and seven diets are shown.

Table 3 Child aged 7 to 10- Day one food list

Grams	FOODNAME
98.14	GARI (CASSAVA FLOUR)
62.77	SR FLOUR AFTER BAKING
55.89	PITTA BREAD, WHOLEMEAL, TOASTED
47.78	MILK SKIMMED WITH ADDED VIT UHT
46.38	MAPLE SYRUP
30.24	EGG, WHOLE, FRIED IN SUNFLOWER OIL
25.41	REDUCED FAT SPREAD (41-62% FAT) NOT POLYUNSATURATED, WITH OLIVE OIL
24.10	POTATO CAKES (SCONES) PURCHASED
23.52	HALO REDUCED CALORIE AND FAT CHOCOLATE BAR
20.22	OAT BRAN
19.43	BLENDED VEGETABLE OIL
14.45	WHITE CHOCOLATE BUTTONS MICE
10.91	BANANA COOKED
10.89	COCONUT DESICCATED UNSWEETENED
10.18	NUT & SUGAR SWEETS
9.84	BREAD ROLLS, WHITE WITH ADDED WHEATGERM
9.56	FLORA PRO ACTIV LIGHT SPREAD ONLY
4.91	GREEN BANANA FRIED RED PALM OIL
3.97	CARROTS FRIED IN PUFA OIL
2.67	WHOLEMEAL FLOUR WITH LOSSES
1.33	CHICKEN TIKKA MASALA WITH RICE, LOW FAT
0.68	LIQUORICE SHAPES

Table 4 Child aged 7 to 10- Day seven food list

Grams	FOODNAME
133.69	PRUNES CANNED IN SYRUP FRUIT & SYRUP
129.56	RICE WHITE LONG GRAIN POLISHED DRIED
121.84	GREEK YOGURT SHEEP
88.50	CASSAVA-FRESH RAW
65.01	TORTILLA CHIPS IN SUNSEED OR HIGH OLEIC SUNFLOWER OIL, EG DORITOS
37.06	PANCAKES MADE WITH GLUTEN FREE FLOUR
23.80	LIGHT SPREADABLE BUTTER (60% FAT)
20.72	BEETROOT UNCOOKED
16.90	KELLOGGS ALL BRAN GOLDEN CRUNCH CEREAL
15.43	FLOUR WHITE SELF RAISING
12.64	CORN MEAL UNSIFTED DRIED
12.21	REDUCED FAT SPREAD (41-62% FAT) POLYUNSATURATED
11.32	UNFORTIFIED MARGARINE (MANUFACTURED PRODUCTS ONLY)- DO NOT USE, SUPPORTS EXISTING RECIPES ONLY
6.13	PARSNIPS BOILED
5.55	MOUSSE, CHOCOLATE, LOW FAT
4.63	INSTANT HOT OAT CEREAL, NOT FLAVOURED, DRY WEIGHT,NOT FORTIFIED WG OATSO SIMPLE
3.88	BISTO SAUCE GRANULES
3.08	FLORA PRO ACTIV EXTRA LIGHT ONLY
1.80	OATS, ROLLED, PLAIN, DRY WEIGHT, NOT QUAKER, READY BREK/ INSTANT OATS
1.35	CLUSTER/GUARE BEANS RAW
1.17	POPPY SEEDS
0.22	THYME DRIED

Table 5 Female 11 to 14 - Day one food list

Grams	FOODNAME
193.60	ENERGY DRINK MIX POWDER MALTODEXTRIN BASED
120.29	OATMEAL WITH COOKING LOSSES
100.84	MILK WHOLE STERILISED
80.41	EGG, WHOLE, FRIED IN SUNFLOWER OIL
58.63	BREAD ROLLS, WHITE WITH ADDED WHEATGERM
56.16	MAPLE SYRUP
30.69	LENTILS CANNED IN TOMATO SAUCE
29.56	BROCCOLI-SPROUTING RAW
20.96	CHILLI PICKLE OILY
20.83	COCONUT DESICCATED UNSWEETENED
16.65	REDUCED FAT SPREAD (41-62% FAT) NOT POLYUNSATURATED, WITH OLIVE OIL
10.49	BLACK TREACLE
9.20	GREEN BANANA FRIED RED PALM OIL
8.54	FLORA PRO ACTIV LIGHT SPREAD ONLY
6.03	CARROTS, YOUNG, FRESH, RAW
5.93	NUT & SUGAR SWEETS
4.16	BLENDED VEGETABLE OIL CRISP 'N' DRY
1.52	ACAI BERRY JUICE DRINK WITH VITAMIN B6
1.42	WHITE CHOCOLATE BUTTONS MICE
0.68	LIQUORICE SHAPES
0.30	CHICKEN TIKKA MASALA WITH RICE, LOW FAT

Table 6 Female 11 to 14 - Day seven food list

Grams	FOODNAME
249.56	MULLER VITALITY PROBIOTIC DRINK
215.54	APPLE JUICE DRINK CARBONATED LOW CALORIE
176.91	PASTA NOODLES EGG BOILED
120.23	ARROWROOT POWDER
68.63	SPINACH CANNED DRAINED
65.63	CASSAVA-FRESH RAW
47.64	SMATANA
46.76	MAYONNAISE NOT LOW CALORIE HOMEMADE
40.34	QUORN SAUSAGE
37.06	WHITE BASMATI RICE DRY
35.21	GLUTEN FREE FLOUR MIX
29.43	POPCORN SALTED E.G. MICROWAVE OR PURCHASED
28.72	LETTUCE-ICEBERG RAW
28.08	CORNMEAL SIFTED DRY
24.30	CHERRIES CANNED IN SYRUP WITH OR WITHOUT STONES FRUIT & SYRU
16.99	CRACKERBREAD, WHOLEMEAL, RYVITA
10.25	BISTO SAUCE GRANULES
6.83	ORGANO DRIED
0.68	FLORA PRO ACTIV EXTRA LIGHT ONLY
0.43	YEAST DRIED
0.37	FRENCH DRESSING

Table 7 Male 11 to 14 - Day one food list

Grams	FOODNAME
229.86	ENERGY DRINK MIX POWDER MALTODEXTRIN BASED
102.88	BREAD ROLLS, WHITE WITH ADDED WHEATGERM
93.69	MILK SKIMMED WITH ADDED VIT UHT
67.25	OATMEAL WITH COOKING LOSSES
65.64	EGG, WHOLE, FRIED IN SUNFLOWER OIL
30.29	BLENDED VEGETABLE OIL
27.01	GARI (CASSAVA FLOUR)
21.47	CHILLI PICKLE OILY
19.93	OAT BRAN
19.54	SR FLOUR AFTER BAKING
17.87	GREEN BANANA FRIED RED PALM OIL
16.06	WHITE CHOCOLATE BUTTONS MICE
14.63	CARROTS FRIED IN PUFA OIL
10.16	WHEATGERM
9.17	FLORA PRO ACTIV LIGHT SPREAD ONLY
6.54	ACAI BERRY JUICE DRINK WITH VITAMIN B6
3.18	TAHINI:SESAME SEED PASTE
1.84	BRAZIL NUTS KERNEL ONLY
1.53	LIQUORICE SHAPES
1.43	CHICKEN TIKKA MASALA WITH RICE, LOW FAT
1.07	SINGLE STRENGTH HIGH JUICE CONC, LOW SUGAR, BLACKCURRANT

Table 8 Male 11 to 14 - Day seven food list

Grams	FOODNAME
432.68	FRUIT JUICE DRINK RTD NAS WITH VITAMINS A,C,E, AND CALCIUM
200.36	FLOUR RICE
106.71	SWEETCORN, BABY COB, CANNED DRAINED NO ADDED SALT OR SUGAR
104.80	TORTILLA CHIPS
100.94	OAT CREAM (NON-DAIRY ALTERNATIVE)
71.45	CORNFLAKES UNFORTIFIED, INCLUDING ORGANIC BRANDS
66.57	TRIFLE, FRUIT PURCHASED WITH FRESH CREAM
63.43	MULLER VITALITY PROBIOTIC DRINK
50.29	YOGURT, VIRTUALLY FAT FREE, NATURAL, UNSWEETENED
28.92	POTATO CRISPS VERY LOW FAT WITH ARTIFICIAL SWEETENER
25.97	BENECOL LIGHT SPREAD
25.70	BEETROOT UNCOOKED
23.51	PASTA SAUCE, CARBONARA TYPE
23.27	MARROW PARWAL BOILED
18.61	INSTANT HOT OAT CEREAL, NOT FLAVOURED, DRY WEIGHT,NOT FORTIFIED WG OATSO SIMPLE
15.51	QUORN SAUSAGE
9.00	THAI FRAGRANT RICE - RAW
5.35	FLORA LIGHTER THAN LIGHT
3.72	EGG YOLK RAW
1.27	THYME DRIED
0.91	OYSTERS RAW

Table 9 Female 15 to 18 - Day one food list

Grams	FOODNAME
305.28	ENERGY DRINK MIX POWDER MALTODEXTRIN BASED
116.17	EGG, WHOLE, FRIED IN SUNFLOWER OIL
110.54	MILK WHOLE STERILISED
56.59	BREAD ROLLS, WHITE WITH ADDED WHEATGERM
49.08	OATMEAL WITH COOKING LOSSES
36.18	GREEN BANANA FRIED RED PALM OIL
24.93	CHILLI PICKLE OILY
22.50	ORANGE PEEL
20.93	BROWN LENTILS BOILED IN SALTED WATER
19.05	MILK SEMI-SKIMMED PASTEURIZED WITH SMP AND VITS A & D
17.03	GARI (CASSAVA FLOUR)
16.43	OAT BRAN
15.11	MAPLE SYRUP
14.18	LIQUORICE SHAPES
13.27	BROAD BEANS DRIED RAW
13.17	COCONUT DESICCATED UNSWEETENED
9.10	BLENDED VEGETABLE OIL
6.06	FLORA PRO ACTIV LIGHT SPREAD ONLY
5.68	GREEN BANANA FRIED IN BLENDED OIL
4.70	BLACK TREACLE
1.35	BRAZIL NUTS KERNEL ONLY
0.31	SOYA PROTEIN POWDER

Table 10 Female 15 to 18 - Day seven food list

Grams	FOODNAME
577.94	APPLE JUICE DRINK CARBONATED LOW CALORIE
333.07	RICE WHITE LONG POLISHED BOILED
215.32	MULLER VITALITY PROBIOTIC DRINK
166.24	PEARS EATING RAW FLESH & SKIN ONLY NO CORE
100.98	CORN BASED SNACKS EG MONSTER MUNCH, WOTSITS, TRANSFORM-A-SNACK
98.40	WHITE BASMATI RICE DRY
77.55	TORTILLA CHIPS
75.77	BEETROOT BOILED (SALTED WATER)
61.21	CHERRIES CANNED IN SYRUP FRUIT ONLY
49.19	ARROWROOT POWDER
44.92	APPLES COOKING BAKED WITHOUT SUGAR FLESH & SKIN ONLY
35.89	SWEETCORN, BABY COB, CANNED DRAINED NO ADDED SALT OR SUGAR
34.12	FLORA PRO ACTIV SKIMMED MILK
33.53	CARROTS-FROZEN BOILED
14.23	BANANA CHIPS WITH ADDED FAT DRIED WEIGHT
10.87	INSTANT HOT OAT CEREAL, NOT FLAVOURED, DRY WEIGHT,NOT FORTIFIED WG OATSO SIMPLE
10.18	HADDOCK STEAMED NO BUTTER
9.53	BANANA DRIED NO ADDED FAT OR SUGAR
7.63	CAVIAR
5.99	DRIED MIXED HERBS
0.89	EGG YOLK FRIED IN BUTTER

Table 11 Male 15 to 18 - Day one food list

Grams	FOODNAME
234.71	ENERGY DRINK MIX POWDER MALTODEXTRIN BASED
155.33	SR FLOUR AFTER BAKING
99.59	EGG, WHOLE, FRIED IN SUNFLOWER OIL
84.02	MILK SKIMMED WITH ADDED VIT UHT
48.66	GREEN BANANA FRIED RED PALM OIL
41.73	RICE WITH LOSSES
37.74	OAT BRAN
37.22	BREAD ROLLS, WHITE WITH ADDED WHEATGERM
33.08	MAPLE SYRUP
31.58	OATMEAL WITH COOKING LOSSES
30.65	WHITE CHOCOLATE BUTTONS MICE
30.19	BLENDED VEGETABLE OIL
13.29	CHILLI PICKLE OILY
10.40	REDUCED FAT SPREAD (41-62% FAT) NOT POLYUNSATURATED, WITH OLIVE OIL
7.77	COCONUT DESICCATED UNSWEETENED
6.70	FLORA PRO ACTIV LIGHT SPREAD ONLY
5.46	BRAZIL NUTS KERNEL ONLY
2.98	SOYA PROTEIN POWDER
1.48	CHICKEN TIKKA MASALA WITH RICE, LOW FAT
1.08	ACAI BERRY JUICE DRINK WITH VITAMIN B6
0.08	CARROTS FRIED IN PUFA OIL

Table 12 Male 15 to 18 - Day seven food list

Grams	FOODNAME
419.74	CORNMEAL PORRIDGE MADE WITH WATER
226.43	CELERY FRESH BOILED
220.44	MULLER VITALITY PROBIOTIC DRINK
112.55	PASTA NOODLES EGG BOILED
112.44	PUDDING RICE - RAW
111.58	RICE WHITE WITH PUFA OIL
96.86	ACTIMEL PROBIOTIC DRINKING YOGURT
89.90	SWEETCORN, BABY COB, CANNED DRAINED NO ADDED SALT OR SUGAR
86.72	WHITE RICE EASY COOK BOILED
63.47	MARROW PARWAL BOILED
56.63	COLESLAW PURCHASED NOT LOW CALORIE
51.92	RICE WHITE FRIED IN LARD
41.82	CARROTS-FROZEN BOILED
41.53	BANANA CHIPS WITH ADDED FAT DRIED WEIGHT
40.86	QUAVERS
28.44	THAI FRAGRANT RICE - RAW
19.44	BISTO SAUCE GRANULES
16.99	GREEN BANANA BOILED
16.39	PURE SOYA SOFT AND CREAMY DAIRY FREE SPREAD
16.03	BETEL NUT KERNEL ONLY
9.32	MUSSELS BOILED WEIGHED WITH SHELL
7.00	HORLICKS ORIGINAL POWDER

Table 13 Female 19 to 50 - Day one food list

Grams	FOODNAME
239.00	ENERGY DRINK MIX POWDER MALTODEXTRIN BASED
98.68	MILK SKIMMED WITH ADDED VIT UHT
82.05	EGG, WHOLE, FRIED IN SUNFLOWER OIL
53.03	GARI (CASSAVA FLOUR)
50.66	BREAD ROLLS, WHITE WITH ADDED WHEATGERM
38.51	GREEN LENTILS, CANNED, DRAINED
30.79	OAT BRAN
25.92	REDUCED FAT SPREAD (41-62% FAT) NOT POLYUNSATURATED, WITH OLIVE OIL
20.83	CHILLI PICKLE OILY
19.86	BROAD BEANS DRIED RAW
17.78	LIQUORICE SHAPES
13.12	COCONUT DESICCATED UNSWEETENED
12.82	GREEN BANANA FRIED RED PALM OIL
11.32	HALO REDUCED CALORIE AND FAT CHOCOLATE BAR
9.60	SOYA PROTEIN POWDER
8.77	FLORA PRO ACTIV LIGHT SPREAD ONLY
4.50	BLENDED VEGETABLE OIL
4.46	CHOCOLATES FILLED WITH CARAMEL/CREME NOT TRUFFLES
3.29	GLUTEN FREE FLOUR MIX
1.85	ORANGE PEEL
1.22	OYSTERS RAW
0.72	CHICKEN TIKKA MASALA WITH RICE, LOW FAT

Table 14 Female 19 to 50 - Day seven food list

Grams	FOODNAME
239.36	CARBONATED DRINK <50% JUICE LOW CAL CANNED
166.61	RICE PUDDING CANNED
128.43	RICE DREAM ALTERNATIVE TO MILK, WITH ADDED CALCIUM
112.09	CHIPS NEW POTS FRESH TAKEAWAY FRIED COMM VEG OIL
105.95	CORNMEAL SIFTED DRY
80.83	WHITE BASMATI RICE DRY
68.11	FLOUR RICE
62.59	WORCESTER SAUCE
49.95	COLESLAW PURCHASED NOT LOW CALORIE
45.96	CABBAGE FROZEN BOILED
39.32	MOUSSE, CHOCOLATE, LOW FAT
34.71	MILK WHOLE CHANNEL ISLAND PASTERIZED WINTER
33.89	TORTILLA CHIPS IN SUNSEED OR HIGH OLEIC SUNFLOWER OIL, EG DORITOS
28.89	BEETROOT BOILED (SALTED WATER)
22.44	SWEET POTATO ROAST/BAKED
20.78	CORN CAKES (100% CORN)
18.14	HALF FAT BUTTER, SALTED, WITH VITAMIN A AND D
16.36	POPCORN SWEET
12.42	CHERRIES CANNED IN SYRUP FRUIT ONLY
12.17	EGG YOLK FRIED IN BUTTER
11.49	MAYONNAISE LOW CALORIE (RETAIL)
0.05	BENECOL LIGHT SPREAD

Table 15 Male 19 to 50 - Day one food list

Grams	FOODNAME
192.56	ENERGY DRINK MIX POWDER MALTODEXTRIN BASED
119.22	RICE WITH LOSSES
101.47	EGG WHITE FRIED IN VEGETABLE OIL
90.49	MILK SKIMMED WITH ADDED VIT UHT
60.45	SR FLOUR AFTER BAKING
55.66	OAT BRAN
38.87	BREAD ROLLS, WHITE WITH ADDED WHEATGERM
35.97	GREEN BANANA FRIED RED PALM OIL
31.04	REDUCED FAT SPREAD (41-62% FAT) NOT POLYUNSATURATED, WITH OLIVE OIL
22.51	ASDA POTATO SCONES FRIED IN VEGETABLE OIL
17.42	COCONUT DESICCATED UNSWEETENED
16.84	CHOCOLATES FILLED WITH CARAMEL/CREME NOT TRUFFLES
14.69	BLENDED VEGETABLE OIL
10.98	CHILLI PICKLE OILY
10.23	FLORA PRO ACTIV LIGHT SPREAD ONLY
8.81	SOYA PROTEIN POWDER
7.87	WHITE CHOCOLATE BUTTONS MICE
7.18	CHOCOLATES FANCY AND FILLED
5.79	BRAZIL NUTS KERNEL ONLY
4.98	EGG, WHOLE, FRIED IN SUNFLOWER OIL
3.80	CHICKEN TIKKA MASALA WITH RICE, LOW FAT
2.53	PANINI WHITE BREAD ROLLS (E.G. M&S)

Table 16 Male 19 to 50 - Day seven food list

Grams	FOODNAME
330.29	PASTA SPAGHETTI BOILED WHITE
234.52	RICE PUDDING UHT PURCHASED NOT CANNED NOT FRUIT
183.44	RICE PUDDING MADE W 1/2 SS MILK 1/2 WATER NO SUGAR
116.86	CASSAVA-FRESH RAW
102.41	RICE WHITE FRIED IN LARD
82.67	CORN BASED SNACKS EG MONSTER MUNCH, WOTSITS, TRANSFORM-A-SNACK
71.58	RICE PUDDING CANNED LOW CAL ARTIFICIAL SWEETENER
55.45	CORN MEAL UNSIFTED DRIED
54.52	COLESLAW PURCHASED NOT LOW CALORIE
29.92	POPCORN SWEET
26.03	CARROTS, YOUNG, FRESH, BOILED
15.75	PASTA, EGG, FRESH, FILLED, WITH MUSHROOMS, BOILED
15.41	FLORA PRO ACTIV EXTRA LIGHT ONLY
14.84	POPCORN SALTED E.G. MICROWAVE OR PURCHASED
13.31	QUORN SLICED MEATS, ALL VARIETIES
12.26	OATMEAL RAW
8.37	MILK SHAKE POWDER
6.71	EGG YOLK ONLY BOILED
4.89	FLOUR RICE
4.19	POPPY SEEDS
3.00	PRAWN CRACKERS

Table 17 Female 50 plus - Day one food list

Grams	FOODNAME
223.29	ENERGY DRINK MIX POWDER MALTODEXTRIN BASED
93.80	MILK SKIMMED WITH ADDED VIT UHT
57.53	BREAD ROLLS, WHITE WITH ADDED WHEATGERM
45.84	EGG, WHOLE, FRIED IN SUNFLOWER OIL
33.88	BROAD BEANS DRIED RAW
32.01	PANINI WHITE BREAD ROLLS (E.G. M&S)
27.21	GREEN BANANA FRIED RED PALM OIL
24.57	HALO REDUCED CALORIE AND FAT CHOCOLATE BAR
22.06	EGG WHITE FRIED IN VEGETABLE OIL
19.68	REDUCED FAT SPREAD (41-62% FAT) NOT POLYUNSATURATED, WITH OLIVE OIL
18.79	OAT BRAN
18.14	CHILLI PICKLE OILY
10.78	BRAZIL NUTS KERNEL ONLY
10.22	CHOCOLATES FANCY AND FILLED
9.90	FLORA PRO ACTIV LIGHT SPREAD ONLY
8.48	COCONUT DESICCATED UNSWEETENED
7.08	SOYA BEAN THREAD - FOO JUK
5.42	GREEN BANANA FRIED IN BLENDED OIL
5.23	JELLY LOW IN SUGAR NOT MADE UP
2.55	CHICKEN TIKKA MASALA WITH RICE, LOW FAT
2.39	SOYA PROTEIN POWDER
0.19	CAPERS

Table 18 Female 50 plus - Day seven food list

Grams	FOODNAME
277.47	RICE PUDDING CANNED LOW CAL ARTIFICIAL SWEETENER
134.08	RICE PUDDING MADE W 1/2 SS MILK 1/2 WATER NO SUGAR
89.33	CHOCOLATE SOYA DESSERT, FORTIFIED
81.68	CASSAVA-FRESH RAW
67.29	CELERY-CANNED DRAINED
49.99	PRAWN CRACKERS
48.51	STRONG BREAD FLOUR WITH COOKING LOSSES
46.04	VERY LOW FAT CRéME FRAICHE
45.90	PASTA NOODLES EGG BOILED
45.04	POPCORN SALTED E.G. MICROWAVE OR PURCHASED
42.48	SEMOLINA PACKET MIX E.G. BIRDS. DRY WEIGHT
39.48	BEETROOT UNCOOKED
37.86	SWEET POTATOES-BOILED
37.19	HUMMUS/HOUMOUS, LOW/REDUCED FAT
31.84	TARKA OR TADKA DAHL PURCHASED OR TAKEAWAY
28.70	RICE WHITE LONG POLISHED BOILED
27.13	CRISPBREAD RYE
21.16	MILLET DRY
20.42	COLESLAW, PURCHASED, VALUE TYPE PRODUCTS ONLY
11.57	RICE DREAM ALTERNATIVE TO MILK, WITH ADDED CALCIUM
10.75	MUSSELS BOILED WEIGHED WITH SHELL
6.47	LOW FAT SPREAD (26-39% FAT) POLYUNSATURATED, FORTIFIED WITH B6, B12, FOLIC ACID

Table 19 Male 50 Plus - Day one food list

Grams	FOODNAME
186.70	ENERGY DRINK MIX POWDER MALTODEXTRIN BASED
135.51	RICE WITH LOSSES
89.63	MILK SKIMMED WITH ADDED VIT UHT
74.48	EGG WHITE FRIED IN VEGETABLE OIL
66.45	BREAD ROLLS, WHITE WITH ADDED WHEATGERM
44.55	OAT BRAN
42.92	REDUCED FAT SPREAD (41-62% FAT) NOT POLYUNSATURATED, WITH OLIVE OIL
23.31	GREEN BANANA FRIED RED PALM OIL
17.67	CHOCOLATES FANCY AND FILLED
15.76	CHILLI PICKLE OILY
14.67	COCONUT DESICCATED UNSWEETENED
14.26	EGG, WHOLE, FRIED IN SUNFLOWER OIL
13.08	BROAD BEANS DRIED RAW
12.95	WHITE CHOCOLATE BUTTONS MICE
11.41	FLORA PRO ACTIV LIGHT SPREAD ONLY
9.10	SOYA PROTEIN POWDER
7.08	POTATO CAKES (SCONES) PURCHASED
7.05	BRAZIL NUTS KERNEL ONLY
6.59	BLENDED VEGETABLE OIL
4.67	ACAI BERRY JUICE DRINK WITH VITAMIN B6
3.66	CHICKEN TIKKA MASALA WITH RICE, LOW FAT
0.58	JELLY LOW IN SUGAR NOT MADE UP

Table 20 Male 50 Plus - Day seven food list

Grams	FOODNAME
245.60	RICE PUDDING MADE W 1/2 SS MILK 1/2 WATER NO SUGAR
186.72	RICE PUDDING UHT PURCHASED NOT CANNED NOT FRUIT
101.24	PASTA SPAGHETTI BOILED WHITE
94.82	CASSAVA-FRESH RAW
73.41	COLESLAW PURCHASED NOT LOW CALORIE
72.73	POPCORN SALTED E.G. MICROWAVE OR PURCHASED
70.39	CORN MEAL UNSIFTED DRIED
69.54	RICOTTA
56.99	CHRISTMAS PUDDING PURCHASED
52.31	MILK PUDDING RICE SAGO SEMOLINA CANNED LOW CAL
48.17	RICE WHITE FRIED BLENDED OIL
43.10	RICE WHITE LONG POLISHED BOILED
40.17	CHIPS NEW POTATOES FRESH FRIED IN POLYUNSATURATED OIL OR MAR
27.24	CORN BASED SNACKS EG MONSTER MUNCH, WOTSITS, TRANSFORM-A-SNACK
26.29	CARROTS-FROZEN BOILED
24.46	OATMEAL RAW
13.13	BEETROOT BOILED (SALTED WATER)
8.38	FLORA LIGHTER THAN LIGHT
2.11	CRAB BOILED
1.28	PARSNIPS BOILED
0.51	MIXED NUTS SHELLS NOT WEIGHED

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