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Linear programming to build food-based dietary guidelines: **Romanian food baskets**

Abstract

Many WHO European Member States have high and increasing prevalence of overweight and obesity, particularly among children and adolescents. Obesity is a major risk factor for the development of noncommunicable diseases (NCDs). Innovative approaches are needed to help develop a healthy diet which prevents NCDs and promotes health. Too high prices for fresh foods, rich in micronutrients and low in energy, are often considered as a barrier to eating a healthy diet. Linear programming methodology can facilitate the development of national healthy food basket recommendations that meet both recommended nutrient intake values and WHO guidance in a cost-efficient manner. This novel approach is applied within the context of food availability in Romania in 2014. How best to implement these food basket recommendations at population and individual level still has to be investigated.

Keywords

CHRONIC DISEASE
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MICRONUTRIENTS
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Abbreviations

Range of food baskets

FNRFB	Fully nutritious Romanian food basket: quantity of foods for one person, or a family, incorporating only recommended nutrient intakes, optimized for price, for a single day
DGFB	Dietary guidelines food basket: quantity of foods for one person, or a family, incorporating only WHO dietary guidelines for healthy food, optimized for price, for a single day
HRFB	Health-promoting Romanian food basket: quantity of foods for one person, or a family, incorporating both the recommended nutrient intakes and WHO dietary guidelines, optimized for price, for a single day
DHRFB	Diversified healthy Romanian food basket: quantity of foods for one person, or a family, incorporating both the recommended nutrient intakes and WHO dietary guidelines, optimized for price, for more than a single day

Other abbreviations

LP	linear programming
NCD	noncommunicable diseases
RAE	retinol equivalent units
RNI	recommended nutrient intake

Executive summary

As in many Member States of the WHO European Region, Romania is seeing an increase in the prevalence of overweight and obesity, particularly among children and adolescents. This is a major risk factor for the development of noncommunicable diseases (NCDs), and innovative approaches using a ("healthy") diet which prevents NCDs and promotes health are required to reduce their prevalence. One of the obstacles to reducing the prevalence of overweight and obesity is considered to be too high prices for fresh foods rich in micronutrients and low in energy density.

This document describes a new approach using linear programming methodology to design national dietary recommendations which aim to prevent both NCDs and micronutrient deficiencies and still be affordable by low income groups. This new approach is applied within the context of food availability in Romania in 2014. Eating the same food every day is unrealistic and too monotonous to be maintained, so this novel approach is used to select a wide range of diverse foods that can be recommended for a period of up to, for example, one month.

The following are the key findings of this report.

- The simplest version of the Romanian food basket that incorporates only WHO food-based dietary guidelines does not meet all the recommended nutrient intake values for, for example, vitamins A, D, K, iodine and calcium.

- The version of a Romanian fully nutritious, health-promoting food basket for a family (two adults, two children) costs 19.65 lei (~€ 4.46) for a day.

- Key nutrients, primarily vitamin D, calcium, potassium and iron, were found to control the overall price.

- The least expensive basket (one day's rations) is monotonous and the linear programming approach is used to select a wide range of foods that can be recommended for a period of up to, for example, one month and still be optimized for the lowest possible cost.

- Compared with the food consumption patterns of the Romanian population in 2011, the dietary recommendations designed here, using the linear programming approach, contain significantly more root vegetables, potatoes and fish and considerably less meat, fats, oils and sugar.

In conclusion, the linear programming methodology can facilitate the development of national dietary recommendations that meet both recommended nutrient intake values and WHO food-based dietary guidelines in a cost-efficient manner. How best to implement these dietary recommendations at population and individual level still has to be investigated.

Background

Healthy food policies have the potential to halve the burden of disability and premature mortality due to unhealthy eating patterns (Mozaffarian & Capewell, 2011). Malnutrition (both over- and undernutrition) remains a problem in countries in central and eastern Europe. Half of Romanian children aged under one year have suffered from iron deficiency anaemia, and the prevalence of stunting was 7% for children under two years or 9% for those aged between two and five years (three times more than the acceptable value of 2.3%) (UNICEF, 2005). This is correlated with a reduction in normal cognitive development in young children. Moreover, national surveys indicate that until 2006, only 10% of Romanian schoolchildren consumed the recommended amount of calcium (800 mg/day) and nearly all Romanian schoolchildren were deficient in vitamin D (Vintilă & Istrat, 2012). Based on these findings, the development of national food-based dietary guidelines that recommend an adequate quantity of the appropriate nutrient-rich fresh foods at affordable prices appears necessary.

In parallel to the undernutrition mentioned above the prevalence of overweight and obesity in Romania is increasing, particularly among children and adolescents (Emandi et al., 2013; Mocanu, 2013). Overweight and obesity are risk factors for the development of noncommunicable diseases (NCDs) such as diabetes type 2, cardiovascular diease and cancer (Després & Lemieux, 2006; Zhang et al., 2008). This results in the triple burden of malnutrition consisting of: obesity and diet-related NCDs, undernutrition and micronutrient deficiencies (Chirita-Emandi et al., 2013), which all contribute to increasing inequalities and slower national socioeconomic development. Many Romanians are trapped in the vicious cycle of poverty and over- and undernutrition, which in turn exacerbates their poverty through their inability to earn a decent income, especially the unemployed, rural families, elderly people, single-parent families and families with many children (WHO, 1998; Darmon et al. 2006).

Food-based dietary guidelines are developed by national authorities and used to communicate information on a healthy diet to the general public (Diethelm et al., 2012). Due to their general nature, however, food-based dietary guidelines may result in a simultaneous increase in the prevalence of micronutrient deficiency and obesity (Smitasiri & Uauy, 2007). Novel approaches are, therefore, needed to develop national dietary guidelines and recommendations that incorporate nation-specific social, economic and political considerations along with cultural diversity to improve population health (Smitasiri & Uauy, 2007).

One new approach being considered by WHO includes linear programming (also called linear optimization) (Ferguson et al., 2006). The results may be more effective compared with usual approaches to the development of national dietary guidelines (Cheskin et al., 2008). For example, in the United States of America the Thrifty Food Plan market basket has been developed by the United States Department of Agriculture (Carlson et al., 2007) and the Canadian government recommends the use of its national nutritious food basket. The Canadian example includes a list of approximately 60 foods that constitute a nutritious diet for a range of males and females of different ages (Ministry of Health Promotion, 2010; Health Canada, 2009).

Beyond the need to promote health, the social acceptability of national food basket recommendations must be considered because a monotonous selection of unfamiliar foods will not be accepted by the population.

Using linear programming, this project implements: (i) all the recommended micronutrient intakes; (ii) the WHO food-based dietary guidelines (WHO, 2003a) to prevent noncommunicable diseases (NCDs), including obesity and diabetes type 2; (iii) the highest possible affordability of available fresh food; and (iv) social and cultural acceptability into designing a range of healthy food baskets for Romania.

Methodology

Collection of food prices and other food-related data

To find out which fresh foods and at what prices were available in Romania, information was collected in four regions at 23 retail outlets during February and March 2014. Retailers were stratified by rural or urban location (Table 1). The strategy on data collection was coordinated with the Romania WHO Country Office.

Table 1. Administrative regions and number of retail outlets where data were collected

Administrative region	Urban area (No.)	Rural area (No.)
Bucharest–Ilfov	Bucharest (3)	Ilfov rural (4)
North-East	Bacău city (3)	Bacău rural (3)
Centre	Sibiu city (2)	Sibiu rural (3)
South-West	Craiova city (3)	Dolj rural (2)

Calculation of food prices

A list was generated of the non- or minimally processed foods available from retailers/markets, using the following criteria:

- all the foods are readily available in Romanian retail outlets;
- all the foods are essential ingredients for preparing traditional Romanian recipes;[1]
- all the foods were approved as typical for the Romanian population by the WHO Romania Country Office;
- the field workers who collected information on food prices had knowledge of local customs, (eating) habits and language.

The initial list comprised 178 foods. Of these, only 168 were easily available from retail outlets and these form the basis for the Romanian food basket calculations (Annex 1).

All the prices in the retail outlets were for one kg of raw food. All nutrients were calculated in the cooked/ready-to-eat foods from food composition tables (see below). To correct for the difference in nutrient composition between raw and ready-to-eat food, the following two factors were adjusted:

- change in water content during preparation (before – after preparation)
- cost of non-edible parts of food (waste such as shells, peel, skins, fruit stones and bones).

The formula applied for this purpose was:

$$Price_{Edible\ food} = \frac{Price_{Raw\ food} * (100\% - \%Water_{Content\ in\ prepared\ food}) * 100\%}{(100\% - \%\ Water_{Content\ in\ raw\ food}) * \%\ Edible\ portion}$$

[1] See the following websites. (i) Wikipedia [website] (2015). Romanian Cuisine. San Francisco: The Wikimedia Foundation (http://en.wikipedia.org/wiki/Romanian_cuisine, accessed 4 June 2015). (ii) Romania [website] (2015). Bucharest: Romanian Tourist Authority (http://romaniatourism.com/romanian-food-wine.html, accessed 4 June 2015). (iii) Romanian cuisine [website] (2015). San Francisco: Recipes Wikia (http://recipes.wikia.com/wiki/ Romanian_Cuisine, accessed 4 June 2015).

Thus loss of micronutrients that occur during preparation (boiling, baking or simmering) and changes in water content were taken into consideration.

All prices were collected in local currency (lei) and median price values for the same foods were calculated.

Food composition tables

At the time this manuscript was prepared, Romanian food composition tables of prepared foods were not available for use by authors of this report. The nutrient contents of foods were, therefore, taken from the United States Department of Agriculture food composition database SR26 (USDA, 2014) or from the Danish national food composition database (National Food Institute, 2009).

Recommended nutrient intakes

All food baskets were matched to cover the average energy requirements and recommended intakes of nutrients for sex and age according to WHO recommendations (WHO, 2003b; WHO, 2004).

The nutrient content of each basket was calculated as the sum of the nutrients in the foods. Food baskets were calculated for each member of a reference family of four: one child aged two to five years, one child aged six to nine years, one woman aged 31–50 years and one man aged 31–50 years. The calculated Romanian Food basket for one day consists of all the foods for all four family members (Annex 2).

Optimization of food basket composition

After the collection of food prices, the data were delivered to the WHO Collaborating Centre in Copenhagen and were used to create the current report.

As the relationships among food quantities, nutrient contents and price are of a linear nature, the resulting system of linear equations can be subjected to linear programming (linear optimization). Optimized solutions for daily food baskets were calculated with Dantzig's simplex method, which is an integral part of the "Solver" add-in in the Microsoft Excel® software package. The following four different types of isocaloric food basket were determined.

1. The fully nutritious Romanian food basket (FNRFB)
   - linear objective function: cost (minimum);
   - decision variables: amount of foods constituting the food basket for only one day;
   - list of constraints: recommended nutrient intakes (WHO).
2. The (food-based) dietary guidelines food basket (DGFB)
   - linear objective function: cost (minimum);
   - decision variables: amount of foods constituting the food basket for only one day;
   - list of constraints: WHO Food-based dietary guidelines.
3. The healthy Romanian food basket (HRFB) (combination of 1 and 2)
   - linear objective function: cost (minimum);
   - decision variables: amount of foods constituting the food basket for only one day;
   - list of constraints: WHO Food-based dietary guidelines AND recommended nutrient intakes.
4. Diversified healthy Romanian food baskets (DHRFBs)
   - linear objective function: cost (minimum);
   - decision variables: amount of foods constituting the food basket for more than one day;
   - list of constraints: WHO dietary guidelines AND recommended nutrient intakes, including other foods to give a wider and less monotonous variety over a longer period.

Composition and prices of different types of food basket

Of the original list of 178 foods, 168 were readily available from retail outlets and these form the basis for all the Romanian food baskets listed in Annex 1. Only 129 foods were readily available from rural retail outlets, while 167 foods were available from urban outlets. The average number of foods from the list available within one outlet in rural areas (63.5, 48.5–80.75) was significantly lower than the number available in urban areas [(93, 78.5–103.5) (median, inter-quartile range); P-value (Mann-Whitney-U test): 0.036].

Fully nutritious food basket (FNFB)

The composition, cost (median price from all sites) and nutrient contents of the FNFB for a family of four is given in Table 2. As this basket was optimized for highest cost-efficacy (affordability), this is the cheapest possible food basket that fulfils all WHO nutrient recommendations. It consists of only 10 food items: dark rye flour, milk, oat bran bread, cabbage, pork liver, mackerel, cheese and very small amounts of chicken and beef liver. The price of this food basket for a family of four was 14.35 lei in February and March 2014.

In the mother's FNFB, iron, vitamin D and calcium were the price-regulating nutrients; the cost of the children's and the father's FNFB were delimited by potassium, calcium, vitamins A, C and D and folate. Optimizing the FNFB for seven micronutrients (iron, vitamin A, folate, calcium, potassium and vitamins C and D) guaranteed coverage of all other micro- and macronutrients within the given energy requirements.

The composition of the urban FNFB overlapped in part with the rural FNFB as four foods (cabbage, mackerel, pork liver and sunflower oil) were available and cost-effective in supplementing nutrients in both rural and urban areas. The rural FNFB was, however, more than one third (36%) more expensive than the urban FNFB (Table 3). Price-constraining nutrients in the rural basket were calcium and vitamins A, C and D, while the cost of the rural basket was delimited by calcium, potassium and vitamin D.

Table 2. Food, quantity, price and nutrient composition of the FNFB for a Romanian family for one day[a]

Amount of food, price per item, nutrient	Rye flour, dark	Bread, oat bran	Cheese, feta type	Cabbage	Mackerel, Atlantic	Pork liver	Oil, sunflower	Beef liver	Milk, 3.7% milk fat	Chicken liver	Total	Relative fulfilment of recommended intake (%)
Amount of food (g)	1 124	995	414	393	210	40	14	12	4	3	3 208	
Price per item (lei)	2.25	2.40	5.79	0.74	2.76	0.40	0.08	0.11	0.02	0.03	14.35	
Energy (Kcal)	3 651	2 349	1 092	98	551	66	123	22	3	4	7 959	100
Protein (g)	179	104	59	5	50	10	0	3	0	1	411	275
Lipids (g)[b]	25	44	88	0	37	2	14	1	0	0	211	
Carbohydrate (g)[b]	771	396	17	23	0	1	0	1	0	0	1 209	
Fibre (g)[b]	267	45	0	10	0	0	0	0	0	0	322	
Sugar (g)[b]	26	77	17	13	0	0	0	0	0	0	132	
Calcium (mg)	416	647	2 039	157	32	4	0	1	5	0	3 300	100
Iron (mg)	56	31	3	2	3	7	0	1	0	0	103	177
Magnesium (mg)	1 798	348	79	47	204	6	0	2	1	1	2 485	375
Phosphorus (mg)	5 606	1 404	1 394	102	585	96	0	57	4	11	9 258	463
Potassium (mg)	8 056	1 463	256	668	843	60	0	41	6	7	11 400	100
Sodium (mg)[b]	22	3 514	3 792	71	175	20	0	9	2	2	7 606	470
Zinc (mg)	57	9	12	1	2	3	0	1	0	0	83	614
Copper (mg)	6.3	1.3	0.1	0.1	0.2	0.3	0.0	1.7	0.0	0.0	10.0	203
Manganese (mg)	68.1	7.8	0.1	0.6	0.0	0.1	0.0	0.0	0.0	0.0	77	496
Selenium (µg)	202	299	62	1	109	27	0	4	0	2	706	692
Vitamin C (mg)	0	0	0	144	1	9	0	0	0	1	155	100
Thiamin (mg)	3.6	5.0	0.6	0.2	0.3	0.1	0.0	0.0	0.0	0.0	9.9	261
Riboflavin (mg)	2.8	3.4	3.5	0.2	0.9	0.9	0.0	0.4	0.0	0.1	12.1	310
Niacin (mg)	48	48	4	1	14	3	0	2	0	0	121	242
Pantothenic acid (mg)	16.4	5.8	4.0	0.8	2.1	1.9	0.0	0.8	0.0	0.2	32.0	188
Vitamin B6 (mg)	5.0	0.7	1.8	0.5	1.0	0.2	0.0	0.1	0.0	0.0	9.3	221
Folate (µg)	371	806	132	169	4	65	0	29	0	15	1 592	120
Vitamin B12 (µg)	0	0	7	0	40	7	0	8	0	0	63	808
Vitamin A (RAE)[c]	11	20	517	20	114	2 155	0	1 092	1	105	4 034	197
Vitamin E (mg)	30.7	4.4	0.7	0.6	2.6	0.1	5.7	0.1	0.0	0.0	44.9	152
Vitamin D (µg)	0.0	0.0	1.7	0.0	18.1	0.1	0.0	0.1	0.0	0.0	20.0	100
Vitamin K (µg)	66	12	7	298	0	12	1	0	0	0	397	241
Saturated fats (g)[b]	3.0	6.9	61.8	0.1	8.8	0.6	1.4	0.3	0.1	0.1	83.1	
Polyunsaturated fats (g)[b]	12.9	17.6	2.4	0.4	13.9	0.4	8.8	0.1	0.0	0.1	57	
Cholesterol (mg)[b]	0	0	368	0	158	142	0	46	1	15	729	
Biotin (µg)	67	27	6	5	15	18	0	4	0	6	147	160
Iodine (µg)	52	198	57	3	176	1	0	0	1	0	488	108
Total n-3 fats (g)[b]	1.6	5.2	0.6	0.3	12.2	0.1	0.0	0.0	0.0	0.0	20.0	
Total n-6 fats (g)[b]	11.3	12.4	1.6	0.1	1.7	0.1	8.8	0.0	0.0	0.0	36	
Trans fats, total (g)[b]	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	

[a] Based on median food prices from the whole country.
[b] Not included in the list of constraints.
[c] Retinol equivalent units.

Table 3. Composition of FNFB for urban and rural areas in Romania

Urban areas			Rural areas		
Food item	**Amount of food (g)**	**Price per item (lei)**	**Food item**	**Amount of food (g)**	**Price per item (lei)**
Milk, 3.7% fat	1 857	5.57	Wheat flour, whole-grain	1 331	3.86
Rye flour, dark	1 236	2.47	Potatoes	767	1.91
Bread, oat bran	722	1.74	Cheese, feta type	457	5.94
Cabbage	313	0.47	Milk, 2% milk fat	254	1.10
Mackerel, Atlantic	223	2.79	Mackerel, Atlantic	152	2.20
Pork liver	48	0.40	Cabbage	120	0.30
Oil, sunflower	33	0.16	Carrots	118	0.29
Beef liver	11	0.10	Pork liver	86	0.96
			Herring, Atlantic	79	0.83
			White bread (French type)	68	0.22
			Cod, Atlantic	44	0.56
			Oil, sunflower	41	0.23
			Spring onions	4	0.02
Total	4 442	13.51	Total	3 522	18.42

The (food-based) dietary guidelines food basket (DGFB)

The criteria for the composition of the DGFB are given in Annex 3. The cost of the DGFB was only 60% (8.55 lei) that of the FNFB, but the recommended intakes of calcium, iodine and vitamins A, K, C, D and biotin were not covered (21%, 36%, 5%, 33%, 34%, 52% and 79%, respectively) (Table 4). Delimiting factors were: vegetables/fruits and omega-3 fatty acids (both: lower bound); protein and omega-6 fatty acids (both: upper bound). In other words, the higher affordability of the DGFB is offset by the limited availability of omega-3 fatty acids and vegetables/fruits and by not including more protein and omega-6 fatty acids. If these requirements are met, the other constraints (contents of sugar, total fat, polyunsaturated and saturated fatty acids, fibre, cholesterol and trans-fatty acids) are achieved automatically. Meeting the recommendation of the dietary guidelines cannot, however, guarantee that the recommended intake values of all micronutrients are met. In particular, the recommended intakes of those nutrients that control the price are not adequately covered.

The healthy Romanian food basket (HRFB)

The composition of the HRFB was calculated to meet both the RNIs and the WHO dietary guidelines. The HRFB comprised 17 foods plus salt (Table 5). The cost of this basket (19.65 lei) was ~40% more than the FNRFB. This higher cost (5.30 lei) is required to cover both WHO's dietary guidelines and all RNIs simultaneously.

The price-delimiting nutrients for family members were calcium, vitamin D and iodine (Table 6). The children's food baskets were delimited by potassium and vitamins A and C. Achieving the vitamin D constraint costs an additional 3.44 lei or 17%. Further factors determining the cost of the HRFB were protein, sugar and polyunsaturated acids (upper bound).

Table 4. Food, quantity, price and nutrient composition of the DGFB for a Romanian family for one day[a]

Nutrients	Beets	Wheat flour	Rye flour, dark	Mackerel, Atlantic	Oil, sunflower	Total	Relative fulfilment of recommended intake (%)
Amount of food (g)	1 464	1 063	738	122	86	3 473	
Price per item (lei)	2.49	2.62	1.48	1.49	0.47	8.55	
Energy (Kcal)	644	3 837	2 399	320	759	7 959	100
Protein (g)[b]	**25**	**127**	**117**	**29**	**0**	**298**	**1**
Lipids (g)[b]	**3**	**18**	**16**	**22**	**86**	**144**	**16**
Carbohydrate (g)[b]	**146**	**771**	**507**	**0**	**0**	**1 423**	**72**
Fibre (g)	**29**	**26**	**176**	**0**	**0**	**230**	
Sugar (g)[b]	**117**	**3**	**17**	**0**	**0**	**137**	**7**
Calcium (mg)	234	159	273	18	0	685	21
Iron (mg)	12	10	37	2	0	60	103
Magnesium (mg)	337	266	1 181	118	0	1 902	287
Phosphorus (mg)	556	1 031	3 684	339	0	5 610	281
Potassium (mg)	4 465	1 063	5 293	489	0	11 310	99
Sodium (mg)	1 127	21	15	101	0	1 265	78
Zinc (mg)	5.1	9.0	37.2	1.1	0.0	52.5	386
Copper (mg)	1.1	1.9	4.1	0.1	0.0	7.3	148
Manganese (mg)	5	8	45	0	0	58	374
Selenium (µg)	10	422	133	63	0	628	616
Vitamin C (mg)	53	0	0	0	0	53	34
Thiamin (mg)	0.4	0.9	2.3	0.2	0.0	3.8	99
Riboflavin (mg)	0.6	0.6	1.9	0.5	0.0	3.6	92
Niacin (mg)	5	11	32	8	0	55	111
Pantothenic acid (mg)	2	5	11	1	0	19	110
Vitamin B6 (mg)	1.0	0.4	3.3	0.6	0.0	5.2	124
Folate (µg)	1 171	351	244	2	0	1 768	133
Vitamin B12 (µg)	0	0	0	23	0	23	297
Vitamin A (RAE)	29	0	7	66	0	103	5
Vitamin E (mg)	1	4	20	2	35	62	210
Vitamin D (µg)	0	0	0	10	0	10	52
Vitamin K (µg)	3	3	44	0	5	54	33
Saturated fats (g)[b]	**0.4**	**2.6**	**2.0**	**5.1**	**8.8**	**19**	**2**
Monounsaturated fats (g)[b]	0.5	1.5	2.1	8.5	16.8	29	3
Polyunsaturated fats (g)[b]	**1.8**	**7.7**	**8.5**	**8.0**	**56.4**	**83**	**9**
Cholesterol (mg)	**0**	**0**	**0**	**92**	**0**	**92**	**9**
Biotin (µg)	0	20	44	9	0	73	79
Iodine (µg)	7	20	34	102	0	163	36
Total n-3 fats (g)[b]	**0.3**	**0.5**	**1.0**	**7.1**	**0.0**	**8.8**	**1**
Total n-6 fats (g)[b]	**1.5**	**6.7**	**7.5**	**1.0**	**54.1**	**71**	**8**
Trans fats, total (g)[b]	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0**

Bold text: critical nutrients determining composition of the DGFB.
[a] Based on median food prices from whole country, optimized for cost.
[b] 100% reference value calculated as percentage of energy requirement.

Table 5. Food, quantity and price of the HRFB for a family for one day[a]

Food item	Amount of food (g)	Price per item (lei)
Carrots	809	1.59
Onions, spring or scallions	582	3.01
Milk, 3.7% milk fat	580	2.15
Potatoes	551	1.28
Cornmeal, whole-grain, yellow	536	1.74
Rye flour, dark	354	0.71
Cheese, Feta type	294	4.12
Mackerel, Atlantic	198	2.43
Bread, oat bran	178	0.43
Bread, French type	133	0.40
Cabbage	91	0.17
Wheat flour	80	0.20
Sugar	77	0.31
Oil, sunflower	76	0.42
Pork liver	39	0.38
Herring, Atlantic	26	0.26
Salt, table	9	0.02
Beef liver	3	0.03
Total	4 617	19.65

[a] Based on median food prices from the whole country, optimized for cost.

Table 6. Micronutrients that delimit the prices of the HRFBs for individual family members

	Minerals		Trace elements		Vitamins		
Family members	Calcium	Potassium	Iodine	Iron	Vitamin D	Folate	Vitamin A
Children	+	+	+		++	+	(+)
Mother	+		+	++	++		
Father	+	+	+		++	+	+

The diversified healthy Romanian food baskets (DHRFBs)

The three baskets described above are designed for only one day and so are monotonous and socially unacceptable. In order to achieve a less monotonous and more realistic variety of foods for a longer period, a basket for a woman aged between 31 and 50 years is used as an example throughout this chapter. Additional HRFBs were calculated by replacing the largest quantity of food with one or more different foods, in most cases from the same category, to give the next cheapest HRFB.

The original HRFB for the woman consisted of 10 foods (including salt) where carrots contributed the largest quantity, followed by onions and then cabbage in the vegetables/fruits category. The relative prices of the first four diversified baskets were 7.39, 7.40, 8.08 and 8.56 lei, respectively (Table 7).

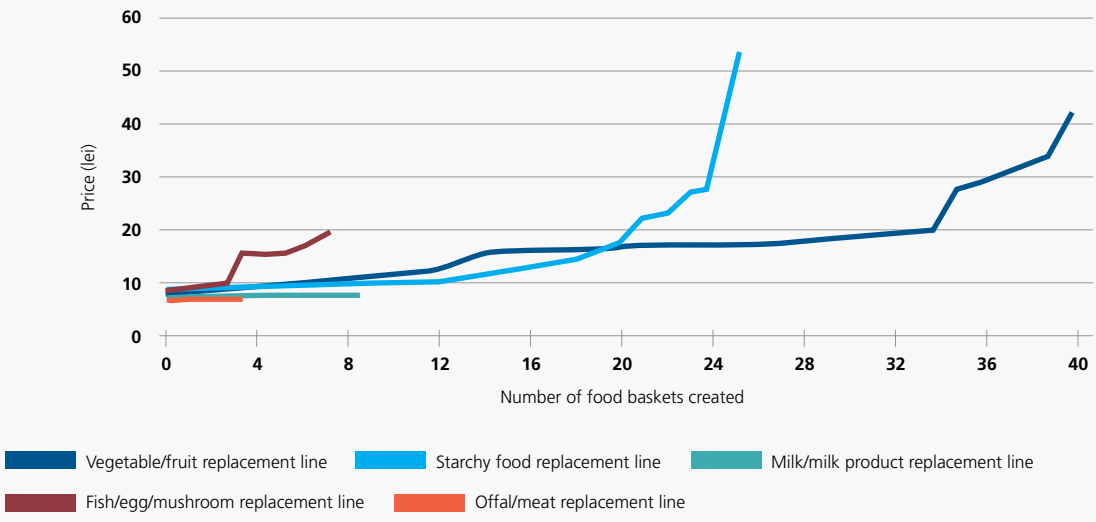
The stepwise substitution resulted in 40 additional different baskets. The same procedure was repeated for starchy foods (which resulted in 25 additional different baskets), offal/meat (three additional different baskets), fish/eggs/mushrooms (six additional different baskets) and milk/milk products (eight additional different baskets). Each replacement sequence started with the full list of 168 Romanian foods and was completed after no more healthy baskets could be constructed. The fewer the number of foods in each category, the fewer the number of baskets that could be constructed and the steeper the price increase. The wider range of foods results in a more varied and less monotonous food basket that can be enjoyed for longer. In addition, food

categories where there are many more foods to choose from result in a less steep increase in price compared with categories with only very few food items, such as fish and eggs (Fig. 1).

Table 7. Food items in the first four HRFBs (HRFB1 = cheapest) where largest quantity of vegetables/fruits was substituted in HRFBs 2-4 to give next cheapest combinations of foods

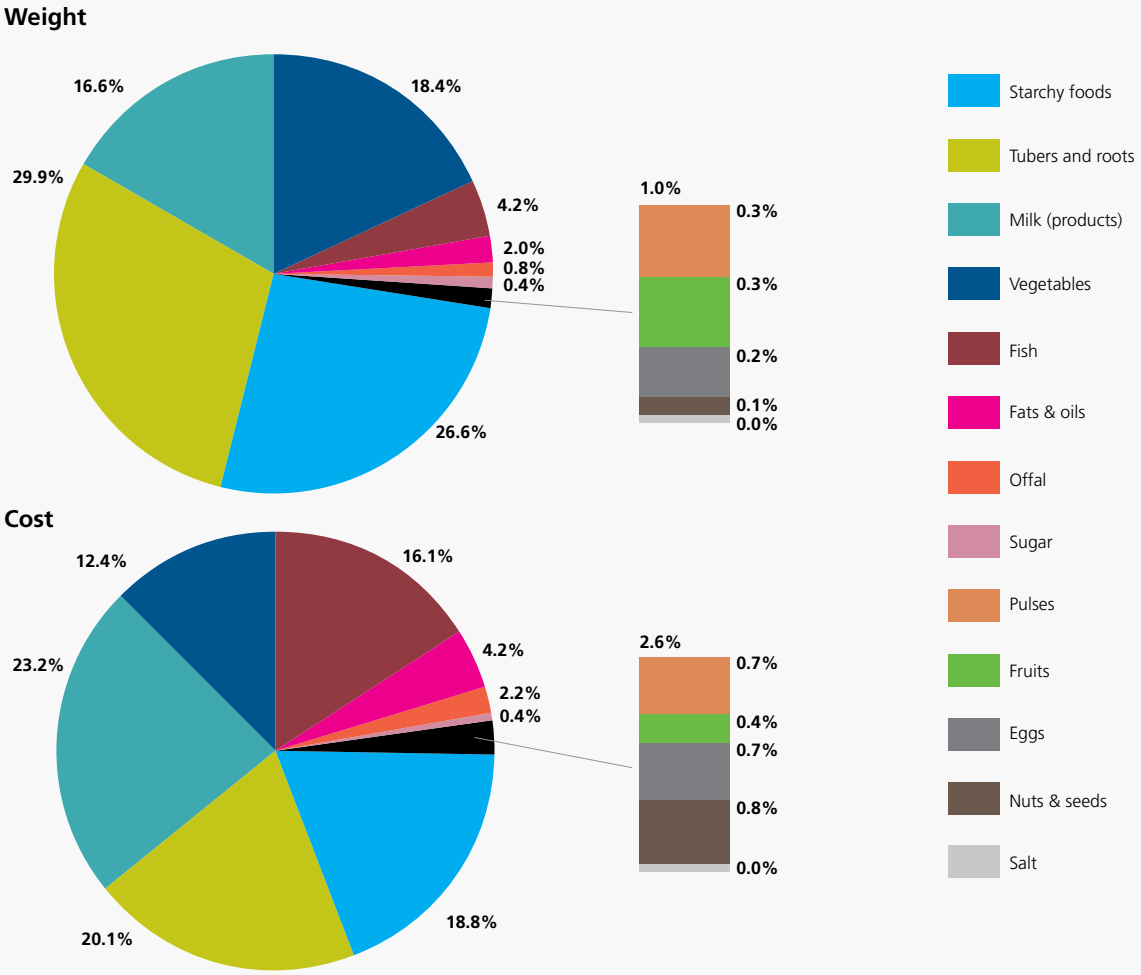
	HRFB 1		HRFB 2		HRFB 3		HRFB 4	
Food item	**Weight (g)**	**Price (lei)**	**Weight (g)**	**Price (lei)**	**Weight (g)**	**Price (lei)**	**Weight (g)**	**Price (lei)**
Carrots	737	1.45	replaced		replaced		replaced	
Onions (scallions)	576	2.98	819	4.24	replaced		replaced	
Cabbage					912	1.71	replaced	
Leeks					211	1.92	343	3.12
Celery							632	1.92
Cornmeal, whole-grain	245	0.80	259	0.84	86	0.28	252	0.82
Rye flour, dark	26	0.05	38	0.08	0.4	0.00	21	0.04
Rice, white					477	1.49		
Milk, 3.7% milk fat	115	0.43	200	0.74	148	0.55	176	0.66
Cheese, feta type	39	0.54	27	0.37	58	0.81	58	0.81
Mackerel, Atlantic	55	0.67	55	0.68	53	0.65	53	0.65
Pork liver	39	0.38	27	0.26	46	0.45	45	0.44
Beans, white					16	0.11		
Oil, sunflower	16	0.09	17	0.09	18	0.10	17	0.10
Margarine, 80% fat			2	0.02				
Sugar			16	0.06				
Salt	3	0.01	4	0.01	3	0.01	2	0.00
Total	1 850	7.39	1 464	7.40	2 030	8.08	1 600	8.56

Figure 1. Prices of HRFBs after stepwise substitution of cheapest foods within categories: vegetable/fruit, starchy food, offal/meat, fish/eggs/mushrooms and milk/milk products



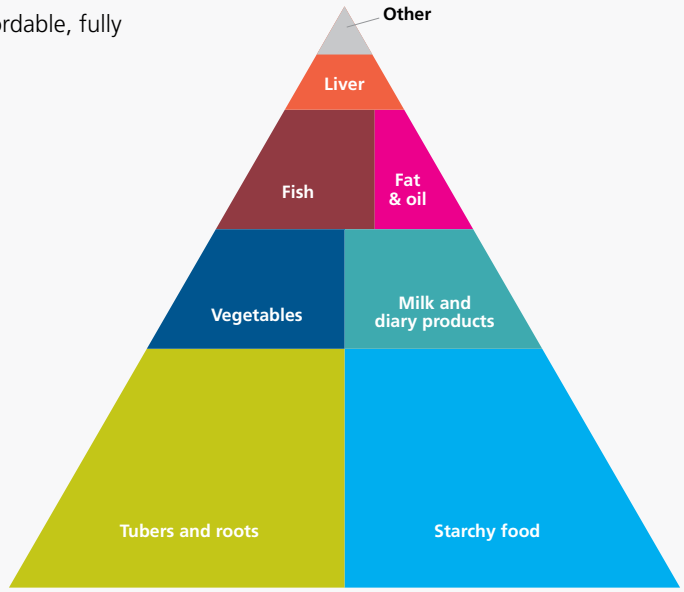
The average quantities and prices of the different food categories in a cost-effective HRFB for the woman are given in Fig. 2.

Figure 2. Average contributions of food categories in 87 HRFBs for the woman, by weight and cost



The proportions of each food category in Fig. 2 are illustrated as a food model or an example of an affordable Romanian food pyramid in Fig. 3.

Figure 3. Romanian food pyramid for affordable, fully nutritious and health-promoting food

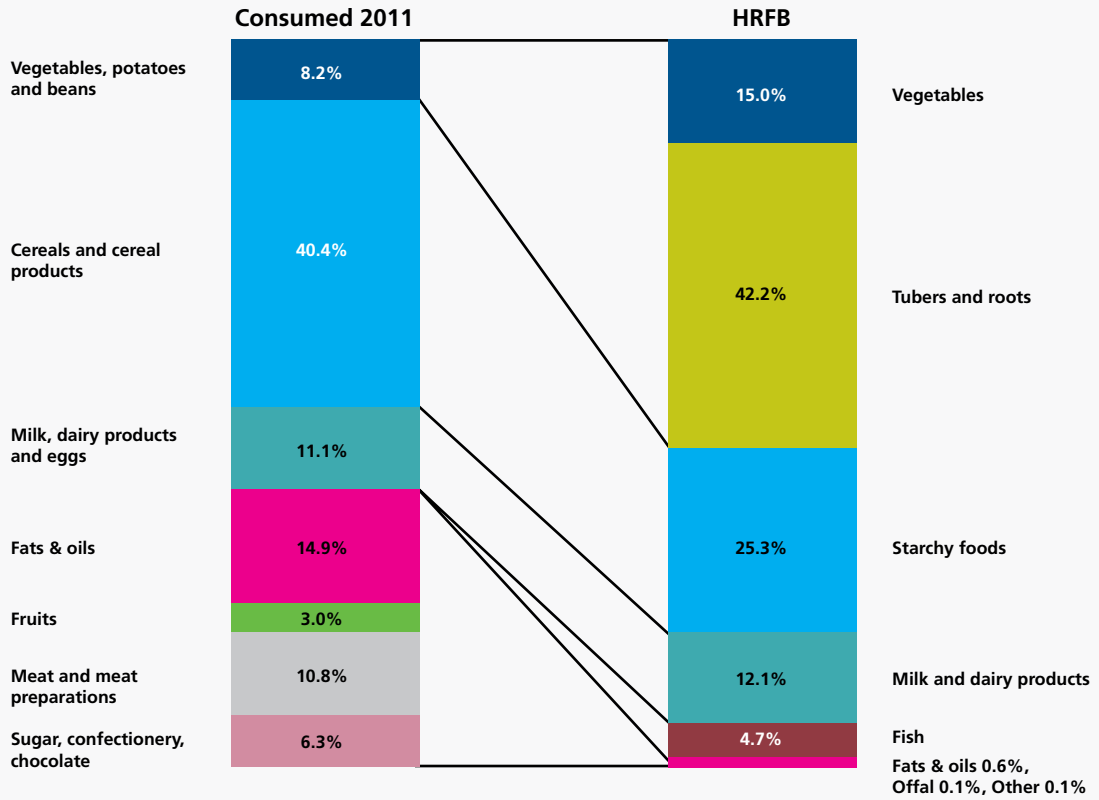


Romanian food consumption patterns have been reported (Luca, 2013). When the healthy food basket, calculated above, is compared with the current intake it is clear that the population could improve their health (through preventing NCDs and micronutrient deficiencies) by increasing their intake of potatoes, root vegetables, leaf vegetables and fish, and reducing their intake of cereals, fats and oil, meat and meat products and sugary products. This would have the added benefit of less money being used to buy food (Fig. 4).

Decreasing monotony and increasing long-term acceptability using linear programming

Planning food baskets for weeks or months, compared with for just one day, requires a wider variety of foods to reduce monotony and increase acceptability along with a better chance of the recommendations being implemented and sustained over time. The inclusion of a wider variety of food results in increased costs, and foods with a lower micronutrient price density are preferentially selected by the linear programming (LP) methodology. The key challenge of the method is to restrict appropriately the weights of single foods depending on the category (meat, offal, milk, milk products, eggs, cereals, vegetables, fruits, pulses, nuts, fats and oils and condiments) by setting upper limits for each.

Figure 4. Comparison between current intake and LP-recommended healthy food basket



Many national authorities have developed food models (WHO 2015) as a simple and understandable way of explaining national dietary guidelines. In most food models (such as pyramids or plates) the relative proportions of different food groups are illustrated in a pictorial format. When, however, the LP method is applied to these food models the relative proportions are redefined because this new approach takes account of the costs of different foods (Fig. 3).

All food categories are represented in the original list of 168 foods. However the LP methodology, which enforces the least expensive solutions, selects foods which come almost exclusively from the categories of cereals, milk and milk products, vegetables (less fruit), fatty fish (no white fish) and oils (only of vegetable origin) and nothing from the meat and meat products category except for small amounts of liver. The relative proportions of these food categories were calculated from the 87 baskets described in Table 8.

Table 8. Relative and absolute contribution of food categories in the 87 HRFBs for the woman

Food category	Average weight (g)	Average weight if included (g)	No. of HRFBs including food category	Percentage included in HRFBs (%)
Vegetables	202	293	60	69
Leaf vegetables	135	356	33	38
Non-leaf vegetables	67	202	29	33
Tubers and roots	693	718	84	97
Fruits and juices	93	244	33	38
Cereals	457	484	82	94
Pulses	51	108	41	47
Seafood, eggs and mushrooms	70	70	87	100
Offal	33	40	71	82
Offal products (liver paté)	8	51	13	15
Milk (products)	201	250	70	80
Fats and oils	26	26	87	100
Nuts and seeds	1	9	12	14
Condiments	52	53	85	98

The LP methodology was used to reduce the monotony of one basket by being used to calculate several varied food baskets for the woman. This analysis resulted in the generation of 87 different baskets (for 87 days or nearly three months). While the fat and oil group and the seafood, eggs and mushroom-group were represented by at least one food in all baskets, nuts and seeds were only in a few and meat (except for liver) was not included. Potatoes and root vegetables, cereals (bread, rice, pasta) and condiments (salt) were in almost all baskets (Table 8).

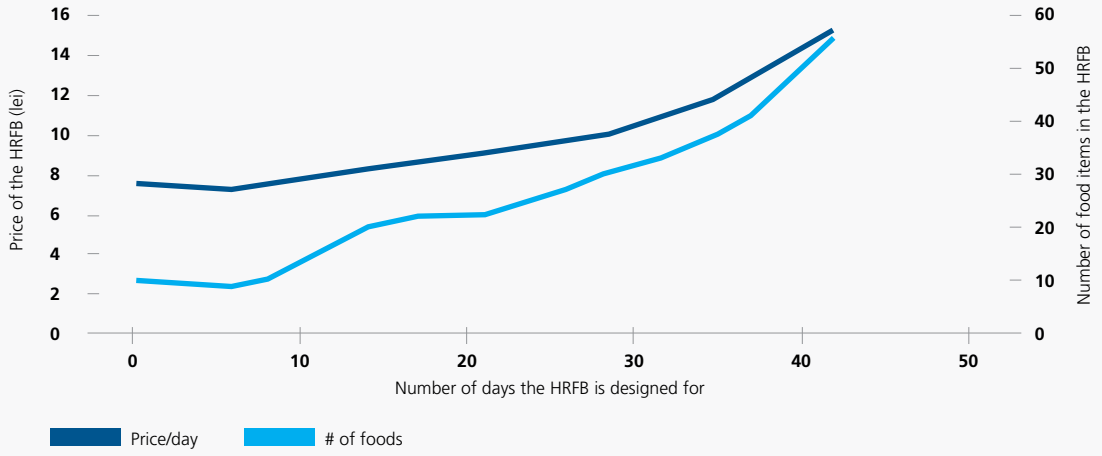
Realistic portion sizes have been estimated (Roberto & Khandpur, 2014) for a notional period of up to six weeks and the total amount of foods calculated. The upper limits for the weight of food were set depending on which category the food belonged to (Table 9). These limits were based on: the relative proportions calculated for the food baskets for one single day, the water content of foods, realistic portion sizes and the lowest weight occurring for one food per serving portion (offal/liver, 100 g). Because five types of offal were included in the original list, the upper limit for the offal category was 500 g.

Table 9. Upper limit for weight of food for notional period of six weeks

Food category	Maximum amount of each food item per HRFB
Tubers and roots	6 000
Starchy food (cereals, flours, bread, rice, pasta, etc.)	2 000
Pulses	500
Milk (any type) and yogurt (any type)	1 500
Milk products (solid, semi-solid and cream)	250
Eggs	1 000
Leaf vegetables	5 000
Non-leaf vegetables	600
Mushrooms	500
Fruits and juices	400
Seafood	500
Meat	250
Offal	500
Oils and fats	500
Condiments, seeds and nuts	250

Fig. 5 illustrates how the price increases over time (42 days in this example) as the diet of the woman is made less monotonous by increasing the variety of foods in the baskets to make the recommendations more acceptable and sustainable. In parallel to the diversification, as foods with a high micronutrient per cost density are replaced with foods having a lower one, the price of the HRFB increases.

Figure 5. Relative price compared with the number of foods included in her HRFB for the woman during a 42-day period



Relatively few foods consistently comprise the food baskets designed for around six weeks: mackerel, whole milk, feta cheese, carrots, scallions and sunflower oil. Fruits, meat and nuts and seeds are hardly in evidence (Table 10).

Relative cost compared with the micronutrient density of foods

Table 11 illustrates those foods that have the highest micronutrient density for the lowest price where the micronutrient-density-price index (expressed as the relative micronutrient composition of the food as percentage of RNI versus the relative cost) for all foods was calculated.

When applying linear optimization to obtain the most cost-effective food baskets (best value for money in relation to the percentage of RNI met), it appears that the foods with the highest micronutrient-density-price index preferentially are selected. For example whole-grain products and liver stand out (Table 11) as two foods that have the highest micronutrient-density-price index. The cost of meeting the RNI for some micronutrients (vitamin B12, selenium and vitamin K) when applying LP is relatively low whereas others are more expensive (calcium, vitamin D, potassium, omega-3 fatty acids and iodine).

One of the challenges of implementing the concept of food baskets, calculated using LP, is how to communicate the message in a simple and easily understandable way. To simplify the process, the foods listed in Table 11 could be recommended as best value for money. Unless these are eaten in the correct quantities and relative proportion, however, the population could still end up suffering from micronutrient deficiencies or diet-related NCDs.

Obesity and micronutrient deficiency

Given the high prevalence of obesity and overweight a large percentage of the population need to reduce their body weight and so need to reduce their energy intake so as to lose weight. The problem is whether obese/ overweight people can lose weight under restricted calorie intake while maintaining their micronutrient status.

Table 12 illustrates the composition of weight-reducing food baskets for the woman where all her micronutrient recommendations are covered at 1300 kcal (compared with 1938 kcal in other food baskets). All these food baskets also meet the requirements for healthy nutrition (WHO, 2003b; WHO, 2004). However, the number (variety) of foods needs to be increased from 10 to 14 to achieve all the recommendations for micronutrients, so the price nearly doubles from 7.39 lei to 14.44 lei. This reinforces earlier research findings (Bogers et al., 2010) to the effect that eating a healthy diet in order to lose weight costs people more money. This may also explain why inequalities in obesity are increasing. Epidemiological data illustrate that inequalities in obesity are increasing exponentially in low socioeconomic groups compared with the levels of obesity plateauing or even decreasing in higher socioeconomic groups (Robertson et al., 2007).

Where the population is not overweight or obese, an eating pattern low in energy but meeting all recommendations for micronutrients allows consumers more flexibility.

Table 10. Foods, quantity (upper limit) and prices of HRFBs for the woman designed for a longer period

			1 day		7 days	
Category	**Food item**	**Maximum weight**	**Weight (g)**	**Price (day)**	**Weight (g)**	**Price (day)**
Tubers and roots	Carrots	6 000	737	1.45	4 809	1.35
	Celeriac					
	Celery					
	Garlic	20g/day				
	Onions (scallions)	6000	576	2.98	4 099	3.03
	Parsnips					
	Potatoes					
Starchy foods	Bread, French type	2 000				
	Bread, oat bran					
	Bread, oatmeal					
	Bulgur					
	Cornmeal, whole-grain		245	0.80	1 736	0.80
	Noodles, with egg					
	Rice, white					
	Rye flour, dark		26	0.05	180	0.05
	Tortillas					
	Wheat flour, whole-grain					
Seafood	Cod, Atlantic	500				
	Herring, Atlantic					
	Mackerel, Atlantic		55	0.67	383	0.67
	Salmon, pink					
	Tuna, fresh, bluefin					
Pulses	Beans, black turtle	500				
	Beans, white					
	Lentils, pink					
	Lentils, green					
	Peas, green, canned					
Offal	Paté, chicken liver, canned	500				
	Pork, heart					
	Pork, liver		39	0.38	266	0.37
Non-leaf vegetables	Beans, snap, green	600				
	Beans, snap, yellow					
	Peas, edible-podded, frozen					
	Peppers, sweet, green, canned					
	Pickles, cucumber					
	Tomatoes, ripe, canned					
Mushrooms	Mushrooms, chanterelle	500				
	Mushrooms, canned					

14 days		21 days		28 days		35 days		42 days	
Weight (g)	Price (day)	Weight (g)	Price (day)	Weight (g)	Price (day)	Weight (g)	Price (day)	Weight (g)	Price (day)
5 350	0.75	4 591	0.43	6 000	0.42	6 000	0.34	6 000	0.28
						5 471	0.91	6 000	0.83
1 339	0.29	5 372	0.78	6 000	0.65	6 000	0.52	6 000	0.43
						16	0.01	840	0.34
6 000	2.22	6 000	1.48	6 000	1.11	6 000	0.89	6 000	0.74
								6 000	0.71
				626	0.05	5 509	0.37	408	0.02
324	0.07	2 000	0.29	2 000	0.21	2 000	0.17	2 000	0.14
		737	0.08	771	0.07	2 000	0.14	2 000	0.11
				1 493	0.26	1 028	0.14	1 395	0.16
				2 000	0.23			2 000	0.20
2 000	0.46	2 000	0.31			2 000	0.19	2 000	0.15
								1 026	0.20
2 000	0.45	2 000	0.30	2 000	0.22	2 000	0.18	2 000	0.15
298	0.04	271	0.03			1 095	0.06	222	0.01
								2 000	0.73
				1 082	0.12				
								199	0.06
				500	0.18	500	0.14	500	0.12
500	0.44	500	0.29	500	0.22	500	0.17	500	0.15
176	0.38	432	0.62	500	0.53	500	0.43	500	0.36
								119	0.25
								500	0.11
500	0.24	500	0.16	500	0.12	500	0.09	500	0.08
								500	0.08
								500	0.07
								500	0.06
264	0.32	500	0.40	500	0.30	500	0.24	500	0.20
								124	0.03
500	0.34	500	0.23	500	0.17	500	0.14	500	0.11
								600	0.12
								600	0.15
						600	0.18	600	0.15
						600	0.12	600	0.10
								600	0.08
						600	0.14	600	0.12
						204	0.75	500	1.53
								500	0.14

Table 10. contd.

Category	Food item	Maximum weight	1 day		7 days	
			Weight (g)	Price (day)	Weight (g)	Price (day)
Milk milk products	Cheese, cheddar	250				
	Cheese, feta		39	0.54	250	0.50
	Cream, fluid, for whipping					
	Cream, sour, reduced fat					
	Milk, non-fat	1 500				
	Milk, 3.7% milk fat		115	0.43	844	0.45
	Milk, 2% milk fat					
	Yogurt, plain, whole milk					
Leaf vegetables	Cabbage	5 000			286	0.08
	Leeks					
	Lettuce, cos or romaine					
	Spinach					
Fruits	Limes	400				
Fats and oils	Butter	500				
	Coconut meat, dried					
	Margarine, 80% fat					
	Oil, olive					
	Oil, sunflower		16	0.09	111	0.09
Eggs	Eggs	1 000				
Condiments	Salt, table	250	3	0.01		
	Vinegar, red wine	20g/day				
	Total amount (g)/price (lei) per day		**1 850**	**7.39**	**12 965**	**7.39**
	No. of food items		10		10	

14 days		21 days		28 days		35 days		42 days	
Weight (g)	**Price (day)**	**Weight (g)**	**Price (day)**	**Weight (g)**	**Price (day)**	**Weight (g)**	**Price (day)**	**Weight (g)**	**Price (day)**
41	0.09	250	0.39	42	0.05				
250	0.25	250	0.17	250	0.13	250	0.10	250	0.08
								250	0.09
								250	0.07
				56	0.01	778	0.11		
1 500	0.40	1 500	0.27	1 500	0.20	1 500	0.16	1 500	0.13
				1 500	0.25	1 500	0.20	436	0.05
934	0.35	1 346	0.33	1 500	0.28	1 500	0.22	1 500	0.19
5 000	0.67	5 000	0.45	5 000	0.33	5 000	0.27	5 000	0.22
		3 857	1.67	5 000	1.62	5 000	1.30	5 000	1.08
								5 000	1.10
				3 385	1.68	5 000	1.98	5 000	1.65
								400	0.16
						500	0.42	500	0.35
								276	0.13
467	0.30	500	0.22	500	0.16	246	0.06		
		121	0.10	355	0.22	220	0.11	500	0.21
87	0.03	199	0.05	282	0.06	500	0.08	431	0.06
						770	0.28	1 000	0.31
40	0.01	33	0.00	42	0.00	19	0.00	24	0.00
				280	0.03	350	0.03	420	0.03
27 569	**8.10**	**38 458**	**9.03**	**50 664**	**9.90**	**67 256**	**11.65**	**83 670**	**15.21**
20		23		30		37		55	

Table 11. Micronutrient-density-price index of foods[a]

Food item	Energy	Carbohydrate	Protein	Magnesium	Iron	Vitamin B6	Phosphorus	Fibre	Zinc	Potassium	Manganese	Thiamine	Niacin
Rye flour, dark	10	16	42	110	41	37	55	66	81	16	121	26	27
Bread, oat bran	6	8	23	20	22		13	10			13	35	25
Wheat flour, whole-grain	6	10	22	58	19	21	25	18	26	5	51	26	19
Bread, multi-whole-grain		5	17	26		10	12	10	13		19	11	12
Beef liver			17		12	19	12		19				24
Cornmeal, whole-grain, yellow	7	11		54	18	16	17	12	18	4	6	20	14
Chicken liver					21	13	10		14				15
Bread, French type	6	9	21		20						7	24	20
Pork kidneys			17		11				17				9
Rye flour, medium	5	8		20			11	15	16	4	22	11	
Pork liver					31				22				11
Beef kidneys			16		11								
Cabbage						11		7		4			
Wheat flours, bread	9	13	26				9				13		
Carrots						13		8		5			
Oats				25			12		13		20	13	
Vegetable oil spread													
Beets				19				7		8	8		
Mackerel, Atlantic													
Oil, corn	5												
Pork, heart													
Potatoes, white				16		15				10			
Bread, oatmeal		5									8	14	
Oil, sunflower	10												
Herring, Atlantic													
Beef, heart			15										
Peanuts, salted, oil-roasted													
Lentils, mature seeds								8					
Spinach													
Broccoli													
Peppers, sweet, green, canned													
Pickles, cucumber													
Celery										4			
Lettuce													
Lentils, pink													
Cheese, feta type													
Sunflower seed kernels, dried													
Rice, brown, medium-grain				15							11		
Oil, olive													
Cod, Atlantic													

[a] Where for example 10 means that one leu could buy the quantity of food that will meet 10% of RNI for specific micronutrient. Foods are included if they rank among the top ten for at least one micronutrient

Pantothenic acid	Riboflavin	Vitamin A (RAE)	Vitamin B12	Copper	Folate	Biotin	Selenium	Sodium	Calcium	Iodine	Vitamin D	Sum n-3 FA	Sum n-6 FA	Vitamin E	Vitamin K	Vitamin C
24	21			28		25	43					4	6	27		
8	24				17		59	49	4	8		12	6			
6				13			91									
				7			37	30	4	4						
26	63	231	647	157	14	30					3					
						25										
24	35	94	149		31	186	42									
	16				25		43	57		6						
12	33		82	9		34	188				2					
				8										7		
16	38	125	161	7		38										
6	55		231	6		22	89				2					
					11				4			2			203	65
6				7			77									
		96												10	35	
				6												
		20						27					19	10	39	
					24											
			129							6	14	26				
												5	60	28		
7	25		28								3					
																18
								30								
													127	149		
			110								11	15				
	20		89													
						48							8	7		
					16	38										
		8													174	
															77	24
								63								21
								50							33	
															62	
		11													56	
					13	32										
								22	6							
													8	19		
													5	16		
										18	2					

Table 11. contd.

Food item	Energy	Carbohydrate	Protein	Magnesium	Iron	Vitamin B6	Phosphorus	Fibre	Zinc	Potassium	Manganese	Thiamine	Niacin
Sugars	6	11											
Peanuts, all types													
Salmon, pink, dry heat													
Milk, 3.7% fat													
Walnuts, English													
Milk, 2% fat													
Yogurt, Greek, plain, non-fat													
Milk, non-fat													
Butter													
Yogurt, plain, whole milk													
Onions, scallions													
Brazil nuts, dried, unblanched													
Peppers, sweet, red													
Paté, chicken liver, canned													
Celeriac													
Oranges, all common varieties													
Kiwifruit, green													
Salami													
Cauliflower													
Pork, cured, ham													
Orange juice, unsweetened													
Paté, liver, pork, canned													
Lemons, without peel													
Garlic						12							
Spaghetti												10	
Beans, kidney													
Chickpeas, mature seeds													
Hazelnuts, blanched											7		
Cream, fluid, for whipping													
Cheese, cheddar													
Egg, whole													
Parsnips										3			
Tuna, white, canned in water													
Tuna, white, canned in oil													

[a] Where for example 10 means that one leu could buy the quantity of food that will meet 10% of RNI for specific micronutrient. Foods are included if they rank among the top ten for at least one micronutrient

Pantothenic acid	Riboflavin	Vitamin A (RAE)	Vitamin B12	Copper	Folate	Biotin	Selenium	Sodium	Calcium	Iodine	Vitamin D	Sum n-3 FA	Sum n-6 FA	Vitamin E	Vitamin K	Vitamin C
													8	7		
											9	6				
									5	6						
												6	6			
									4	5						
									4	5						
									4	4						
		5										3				
									4	4						
															200	
							78									
																47
			40													
															35	
																32
																31
								20								
																19
								18								
																17
		17														
																14
					10											
					10											
		4														
									4							
											3					
												3				
											1					

Table 12. Weight-reducing food baskets for the woman covering all micronutrient recommendations within a range between 1 300 and 1 938 kcal

Category	Food	Weight (g)	Price (lei)	Weight (g)	Price (lei)	Weight (g)	Price (lei)
Fats and oils	Oil, olive					2	0.04
Fats and oils	Oil, sunflower	16	0.09	15	0.08	14	0.08
Fats and oils	Margarine, 80% fat						
Fats and oils	Butter						
Leaf vegetables	Leeks, bulb and lower leaf						
Leaf vegetables	Spinach						
Non-leaf vegetables	Sweet pepper, green, canned						
Meat	Paté, chicken liver, canned						
Milk (products)	Milk, 3.7% milk fat	115	0.43	148	0.55	157	0.58
Milk (products)	Cheese, feta	39	0.54	11	0.16		
Milk (products)	Yogurt, plain, whole milk						
Offal	Pork liver	39	0.38	26	0.25	21	0.20
Seafood	Mackerel, Atlantic	55	0.67	56	0.69	57	0.70
Seafood	Cod, Atlantic						
Seafood	Salmon, pink						
Starchy foods	Cornmeal, whole-grain, yellow	245	0.80	242	0.78	181	0.59
Starchy foods	Rice, white, medium-grain					119	0.37
Starchy foods	Rye flour, dark	26	0.05	27	0.05	25	0.05
Tubers and roots	Carrots	737	1.45	490	0.96	345	0.68
Tubers and roots	Onions, scallions	576	2.98	812	4.20	937	4.85
Tubers and roots	Celery						
Condiments	Salt, table	3	0.01	3	0.01	4	0.01
Condiments	Vinegar, from red wine						
	Total cost per day		7.39		7.74		8.14
	Relative energy content of the nominal food basket (1 938 kcal)	100%		95%		90%	

Weight (g)	Price (lei)	Weight (g)	Price (lei)	Weight (g)	Price (lei)	Weight (g)	Price (lei)	Weight (g)	Price (lei)
7	0.12	12	0.07	9	0.16	0.4	0.01	14	0.24
13	0.07	13	0.22	12	0.06			10	0.06
						34	0.31		
								4	0.11
				186	1.69	231	2.10	402	3.65
				66	0.91	247	3.43	407	5.65
								27	0.20
				31	0.52	37	0.63	33	0.55
149	0.55	109	0.41	188	0.70	116	0.43		
								184	0.96
22	0.21	20	0.19	7	0.07				
57	0.70	50	0.61	39	0.47	17	0.20		
		5	0.06	2	0.03	13	0.16	10	0.13
		4	0.13	12	0.36	26	0.78	36	1.07
81	0.26								
321	1.00	465	1.45	414	1.29	354	1.10		
22	0.04	19	0.04	10	0.02				
271	0.53	209	0.41						
982	5.08	1 076	5.57	796	4.12	475	2.46		
						274	0.83	254	0.77
3	0.01	3	0.01	3	0.01	2	0.00	0.3	0.00
						20	0.06	20	0.06
	8.58		9.17		10.42		12.51		14.44
85%		80%		75%		70%		67%	

Limitations of the design of healthy food baskets

The cost calculated include only the cost of the foods; extra money is needed by the consumer to convert these foods into tasty meals. Other cost need to be added to ensure the population can afford a healthy eating pattern, namely:

- cost of travel and food shopping transportation
- variations in food prices due to the selling policies of retailers
- cost of equipment to store, prepare and consume meals (refrigerators, freezers, pots, dishes, cutlery, oven)
- costs of water and fuel for food storage and preparation (cooking, refrigerating, freezing)
- cost of time to prepare meals (assuming that the cook might otherwise earn an income)
- seasonal fluctuations in food prices
- trends in and volatility of food prices because of the global market
- fluid intake from of drinks.

Ideally the cost of a national food basket should be based on national data taking account of all the above conditions.

Ideally food baskets should be based on data from national food intake surveys. Some Romanian data exist (Luca, 2013) and these can serve as a basis to assess how current dietary patterns should change so as to resemble healthier eating patterns and at what cost for low income Romanians (Fig. 4). The cost of the cheapest food basket for a Romanian family of four for a month (30.5 days) was almost 600 (598.1) lei in March 2014 compared with the average Romanian monthly net income in December 2013 of 1 760 lei per person (INSSE, 2014). Assuming both adults earned this income, 17% of their earnings should be spent on food alone if they wish to ensure that the whole family has access to their recommended micronutrients.

Concluding remarks

1. *Both WHO RNI values and food-based dietary guidelines should be incorporated into the design of national dietary recommendations.*
   If national dietary recommendations and food models are designed using only dietary goals to reduce NCDs, micronutrient deficiencies could readily occur, especially in the overweight or obese who are trying to lose weight through restricting their energy intake.

2. *The least expensive version of the food basket is calculated for one day. However, the same few foods cannot be eaten day-in day-out without the diet becoming monotonous and socially unacceptable.*
   If the food basket recommendations are to be realistic and implemented by the population for sustainable periods of time, the number and variety of foods have to be increased by an optimized approach (LP) where price is taken into consideration.

3. *LP can be applied to reduce the monotony of the food baskets.*
   Two LP strategies can be applied to broaden the variety of foods and thus increase acceptability and long-term implementation to improve public health. In the food replacement strategy, where the diversity of a food basket can be increased by replacing foods that prevail in an HRFB with other foods (in most cases from the same food category), the process is cost-optimized by LP. In the long-term planning strategy, the number of foods for, for example, the woman can be increased from 10 to 55 by extending the period from one day to six weeks. The corresponding increase in cost doubles from approximately 7.50 to 15 lei/day. Consequently, the food needed to ensure a healthy diet would require more than one third (35%) of the family income.

4. *LP can be applied to produce fully nutritious food baskets with a lower energy content that nevertheless meet all the RNI values.*
   When recommending hypocaloric diets, LP should be used to guarantee appropriate coverage of all RNI values. The design of healthy food baskets with an energy content that is about one third lower can, however, lead to a doubling of the cost.

References

Bogers RP1, Barte JC, Schipper CM, Vijgen SM, de Hollander EL, Tariq L et al. (2010). Relationship between costs of lifestyle interventions and weight loss in overweight adults. Obes Rev. 11(1):51–61. doi: 10.1111/j.1467-789X.2009.00606.x.

Carlson A, Lino M, Juan W-Y, Hanson K, Basiotis PP (2007). Thrifty Food Plan, 2006. Alexandria, VA: U.S. Department of Agriculture, Center for Nutrition Policy and Promotion (CNPP-19; http://www.cnpp.usda.gov/sites/default/files/usda_food_plans_cost_of_food/TFP2006Report.pdf, accessed 9 June 2015).

Cheskin LJ, Mitchell AM, Jhaveri AD, Mitola AH, Davis LM, Lewis RA et al. (2008). Efficacy of meal replacements versus a standard food-based diet for weight loss in type 2 diabetes: a controlled clinical trial. Diabetes Educ. 34:118–27.

Chirita-Emandi A, Puiu M, Gafencu M, Pienar C (2013). Arterial hypertension in school-aged children in Western Romania. Cardiol Young. 23:189–96.

Darmon N, Ferguson EL, Briend A (2006). Impact of a cost constraint on nutritionally adequate food choices for French women: an analysis by linear programming. J Nutr Educ Behav.38:82–90.

Després JP, Lemieux I (2006). Abdominal obesity and metabolic syndrome. Nature. 444:881–7.

Diethelm K, Jankovic N, Moreno LA, Huybrechts I, De Henauw S, De Vriendt T et al. HELENA Study Group (2012). Food intake of European adolescents in the light of different food-based dietary guidelines: results of the HELENA (Healthy Lifestyle in Europe by Nutrition in Adolescence) Study. Public Health Nutr.15:386–98.

Dunford E, Trevena H, Goodsell C, Ng KH, Webster J, Millis A et al. (2014). FoodSwitch: a mobile phone app to enable consumers to make healthier food choices and crowdsourcing of national food composition data. JMIR Mhealth Uhealth. August 21;2(3):e37.

Emandi AC, Puiu M, Gafencu M, Pienar C (2013). Overweight and obesity in school age children in Western Romania. Rev Med Chir Soc Med Nat Iasi. 117:36–45.

FAO/WHO/UNU (2002). FAO/WHO/UNU Expert Consultation on Protein and Amino Acid Requirements in Human Nutrition. Geneva: World Health Organization; (WHO Technical Report Series, No. 935; http://whqlibdoc.who.int/trs/who_trs_935_eng.pdf, accessed 9 June 2015).

Ferguson EL, Darmon N, Fahmida U, Fitriyanti S, Harper TB, Premachandra IM (2006). Design of optimal food-based complementary feeding recommendations and identification of key "problem nutrients" using goal programming. J Nutr. 136:2399–404.

Health Canada [website] (2009). National Nutritious Food Basket. Ottawa: Health Canada (http://www.hc-sc.gc.ca/fn-an/surveill/basket-panier/index-eng.php, accessed 9 June 2015).

INSSE (2014). Average earnings in December 2013. Bucharest: National Institute of Statistics (Press release No. 30 of February 6, 2014; http://www.insse.ro/cms/files/statistici/comunicate/castiguri/a13/cs12e13.pdf, accessed 9 June 2015).

Luca L (2013). Changes in food consumption pattern of households in Romania in the period 2004–2011. Bulletin UASVM Horticulture.70:344–9.

Ministry of Health (2010). Nutritious food basket. Guidance document. Toronto: Ministry of Health Promotion, Standards, Programs & Community Development Branch (http://www.mhp.gov.on.ca/en/healthy-communities/public-health/guidance-docs/NutritiousFoodBasket.PDF, accessed 9 June 2015).

Mocanu V (2013). Prevalence of overweight and obesity in urban elementary school children in northeastern Romania: its relationship with socioeconomic status and associated dietary and lifestyle factors. Biomed Res Int.2013:537451. doi: 10.1155/2013/537451. Epub 2013 Jul 14.

Mozaffarian D, Capewell S (2011). United Nations' dietary policies to prevent cardiovascular disease. BMJ. September 14;343:d5747.

National Food Institute, DTU Food (2009). The official Danish Food Composition Database, version 7.01 [online database]. Søborg: Technical University of Denmark, National Food Institute (http://www.foodcomp.dk/v7/fcdb_download.asp, accessed 9 June 2015).

Roberto CA, Khandpur N (2014). Improving the design of nutrition labels to promote healthier food choices and reasonable portion sizes. Int J Obes (Lond). 38(Suppl.1):S25–33.

Robertson A, Lobstein T, Knai C [e-report] (2007). Obesity and socio-economic groups in Europe: evidence review and implications for action. Brussels: European Commission (unpublished document; http://ec.europa.eu/health/ph_determinants/life_style/nutrition/documents/ev20081028_rep_en.pdf, accessed 10 June 2015).

Smitasiri S, Uauy R (2007). Beyond recommendations: implementing food-based dietary guidelines for healthier populations. Food Nutr Bull.28(1. Suppl):S141–51.

UNHCR, UNICEF, WFP, WHO (2003). Food and nutrition needs in emergencies. Geneva: World Health Organization (http://whqlibdoc.who.int/hq/2004/a83743.pdf. accessed 9 June 2015).

UNICEF (2005). Nutritional status of pregnant women, children under 5 years old and schoolchildren aged 6–7 years. Bucharest: "Alfred Rusescu" Institute for Mother and Child Care (http://www.unicef.org/romania/brochure_final_En.pdf, accessed 9 June 2015).

USDA (2014). Composition of foods raw, processed, prepared. USDA National Nutrient Database for Standard Reference. Documentation and User Guide Release 26, 2014. Beltsville, MD: U.S. Department of Agriculture (https://www.ars.usda.gov/SP2UserFiles/Place/80400525/Data/SR26/sr26_doc.pdf, accessed 9 June 2015).

Vintilă M, Istrat D (undated). Early childhood nutrition education for a healthy mind and body. Timişoara: West University (http://www.nutgecs.eu/outcomes/ro/RO-Early_childhood_nutrition_education_for_a_healthy_mind_and_body.pdf, accessed 9 June 2015).

WHO (1998). Comparative analysis of nutrition policies in WHO European Member States. Copenhagen: WHO Regional Office for Europe (http://www.euro.who.int/__data/assets/pdf_file/ 0020/130547/ E60770.pdf, accessed 9 June 2015).

WHO (2003a). Food-based dietary guidelines in the WHO European Region. Copenhagen: WHO Regional Office for Europe (http://www.euro.who.int/__data/assets/pdf_file/ 0017/150083/E79832.pdf, accessed 9 June 2015).

WHO (2003b). Diet, nutrition and the prevention of chronic diseases. Geneva: World Health Organization (WHO Technical Report Series: No. 916; http://whqlibdoc.who.int/trs/who_ trs_916.pdf, accessed 9 June 2015).

WHO (2004). Food and health in Europe: a new basis for action. Copenhagen: WHO Regional Office for Europe (WHO Regional Publications. European series: No. 96; http://www.euro.who.int/__data/ assets/pdf_file/0005/74417/E82161.pdf, accessed 9 June 2015).

WHO (2015). European Database on Nutrition, Obesity and Physical Activity (NOPA) [online database]. Copenhagen: WHO Regional Office for Europe (http://data.euro.who.int/nopa/, accessed 9 June 2015).

Zhang C, Rexrode KM, van Dam RM, Li TY, Hu FB (2008). Abdominal obesity and the risk of all-cause, cardiovascular and cancer mortality: sixteen years of follow-up in US women. Circulation. 117:1658–67.

Annex 1

FOOD ITEM AVAILABILITY IN RURAL AND URBAN AREAS

Category	Foods	Urban areas	Rural areas
Meat	Chicken, broilers or fryers	✔	✔
Meat	Chicken, breast tenders	✔	✔
Meat	Chicken, drumsticks and thighs	✔	✔
Meat	Turkey, all classes, back	✔	✔
Meat	Turkey, wing, from whole bird	✔	
Meat	Duck, domesticated	✔	✔
Meat	Pork, ground, 72% lean/28% fat	✔	✔
Meat	Pork, fresh, loin, chops	✔	
Meat	Pork, ground, 84% lean/16% fat	✔	
Meat	Beef, ground, 70% lean/30% fat	✔	✔
Meat	Beef, cuts, lean and fat	✔	✔
Meat	Pork, cured, ham, boneless	✔	✔
Meat	Beef + pork, ground, 71% lean/29% fat	✔	✔
Meat	Veal, ground	✔	
Meat	Lamb, ground	✔	
Meat	Lamb, ground	✔	✔
Meat	Salami, beef	✔	✔
Meat	Paté, chicken liver, canned	✔	✔
Meat	Paté, liver, pork, canned	✔	✔
Meat	Smoked link sausage, pork	✔	✔
Meat	Pork, fresh, enhanced, tenderloin, lean	✔	✔
Offal	Beef, liver	✔	
Offal	Beef, heart	✔	
Offal	Beef, kidneys	✔	
Offal	Pork, liver	✔	✔
Offal	Pork, heart	✔	✔
Offal	Pork, kidneys	✔	✔
Offal	Chicken, liver	✔	✔
Seafood	Cod, Atlantic	✔	✔
Seafood	Salmon, pink	✔	✔
Seafood	Mackerel, Atlantic	✔	✔
Seafood	Tuna, fresh, bluefin	✔	
Seafood	Tuna, white, canned in water	✔	✔
Seafood	Tuna, white, canned in oil	✔	✔
Seafood	Shrimp, mixed species, canned	✔	✔
Seafood	Mussel, blue	✔	✔
Seafood	Herring, Atlantic	✔	
Eggs	Egg, whole	✔	✔
Milk(products)	Milk, non-fat, fluid, added vitamins A and D	✔	✔
Milk(products)	Milk, non-fat, fluid, no added vitamins	✔	✔

Category	Foods	Urban areas	Rural areas
Milk(products)	Cream, fluid (for whipping)	✔	✔
Milk(products)	Cream, sour, cultured	✔	✔
Milk(products)	Sour cream, reduced fat	✔	✔
Milk(products)	Yogurt, Greek, plain, non-fat	✔	✔
Milk(products)	Yogurt, plain, whole milk	✔	✔
Milk(products)	Yogurt, Greek, plain, non-fat	✔	
Milk(products)	Buttermilk, cultured, low-fat	✔	
Milk(products)	Cheese, cottage, non-fat	✔	✔
Milk(products)	Cheese, cottage, creamed	✔	✔
Milk(products)	Cheese, cottage, low-fat, 1% milk fat	✔	✔
Milk(products)	Cheese, gouda	✔	✔
Milk(products)	Cheese, mozzarella, whole milk	✔	✔
Milk(products)	Cheese, feta	✔	✔
Milk(products)	Cheese, cheddar	✔	✔
Milk(products)	Cheese, camembert	✔	✔
Starchy foods	Bread, French or Vienna	✔	✔
Starchy foods	Bread, multi-grain (includes whole-grain)	✔	✔
Starchy foods	Bread, oatmeal	✔	✔
Starchy foods	Bread, oat bran	✔	
Starchy foods	Tortillas, corn	✔	
Starchy foods	Bulgur	✔	
Starchy foods	Oats	✔	✔
Starchy foods	Wheat flour, white, enriched, bleached	✔	✔
Starchy foods	Wheat flour, whole-grain	✔	✔
Starchy foods	Rye flour, medium	✔	
Starchy foods	Rye flour, dark	✔	
Starchy foods	Cornmeal, whole-grain, yellow	✔	✔
Starchy foods	Rice, white, medium-grain	✔	✔
Starchy foods	Rice, brown, medium-grain	✔	
Starchy foods	Spaghetti, enriched	✔	✔
Starchy foods	Noodles, egg, enriched	✔	✔
Starchy foods	Couscous, cooked	✔	✔
Pulses	Lentils, green, mature seeds	✔	
Pulses	Lentils, pink, mature seeds	✔	
Pulses	Peas, green	✔	✔
Pulses	Peas, green, canned	✔	✔
Pulses	Beans, kidney, mature seeds, sprouted	✔	✔
Pulses	Beans, white, mature seeds, without salt	✔	✔
Pulses	Beans, black, mature seeds, with salt	✔	
Pulses	Beans, kidney, red, mature seeds, canned	✔	✔

FOOD ITEM AVAILABILITY IN RURAL AND URBAN AREAS

Category	Foods	Urban areas	Rural areas
Milk(products)	Milk, 3.7% milk fat	✔	✔
Milk(products)	Cream (coffee cream or table cream)	✔	
Pulses	Peanuts	✔	✔
Pulses	Peanuts, oil-roasted, with salt	✔	✔
Tubers and roots	Potatoes, white	✔	✔
Tubers and roots	Carrots, canned, drained, without salt	✔	✔
Tubers and roots	Onions	✔	✔
Tubers and roots	Onions, spring or scallions (tops and bulb)	✔	✔
Tubers and roots	Garlic	✔	✔
Tubers and roots	Radishes	✔	✔
Tubers and roots	Parsnips, drained, with salt	✔	✔
Tubers and roots	Beets, boiled, drained, with salt	✔	✔
Tubers and roots	Celery, drained, with salt	✔	✔
Tubers and roots	Celeriac, drained, with salt	✔	✔
Leafy vegetables	Cabbage	✔	✔
Leafy vegetables	Leeks	✔	✔
Leafy vegetables	Lettuce, cos or romaine	✔	✔
Leafy vegetables	Lettuce, iceberg (including crisphead types)	✔	
Leafy vegetables	Spinach	✔	✔
Non-leaf vegetables	Tomatoes, red, ripe	✔	✔
Non-leaf vegetables	Cucumber	✔	✔
Non-leaf vegetables	Peppers, sweet, green, drained	✔	✔
Non-leaf vegetables	Squash	✔	✔
Non-leaf vegetables	Peas, edible-podded, frozen	✔	✔
Non-leaf vegetables	Peas, green, canned, seasoned	✔	✔
Non-leaf vegetables	Beans, snap, green	✔	✔
Non-leaf vegetables	Beans, snap, yellow, drained	✔	✔
Non-leaf vegetables	Corn, sweet, yellow, drained	✔	✔
Non-leaf vegetables	Broccoli, drained	✔	✔
Non-leaf vegetables	Cauliflower, drained	✔	✔
Non-leaf vegetables	Avocados	✔	✔
Non-leaf vegetables	Eggplant	✔	✔
Mushrooms	Mushrooms, white	✔	✔
Mushrooms	Mushrooms, chanterelle	✔	
Mushrooms	Mushrooms, canned, drained	✔	
Fruits	Apples, with skin	✔	✔
Fruits	Pears	✔	✔
Fruits	Bananas	✔	✔
Fruits	Oranges	✔	✔
Fruits	Tangerines	✔	✔
Fruits	Grapefruit, pink, red and white	✔	✔
Fruits	Lemons	✔	✔
Fruits	Limes	✔	
Fruits	Pineapple	✔	✔

Category	Foods	Urban areas	Rural areas
Pulses	Chickpeas, mature seeds, with salt	✔	
Pulses	Soybeans		✔
Fruits	Peaches	✔	
Fruits	Apricots	✔	
Fruits	Plums	✔	
Fruits	Kiwifruit, green	✔	✔
Fruits	Strawberries	✔	✔
Fruits	Blueberries	✔	
Fruits	Raspberries	✔	
Fruits	Grapes, red or green	✔	✔
Fruits	Melons, honeydew	✔	
Fruits	Watermelon	✔	
Fruits	Mangos	✔	
Fruits	Dates, Deglet Noor	✔	
Juices	Orange juice, unsweetened	✔	✔
Juices	Apple juice, unsweetened	✔	✔
Juices	Grape juice drink, canned	✔	✔
Nuts and seeds	Almonds	✔	✔
Nuts and seeds	Hazelnuts or filberts	✔	✔
Nuts and seeds	Hazelnuts or filberts, blanched	✔	✔
Nuts and seeds	Walnuts	✔	✔
Nuts and seeds	Brazil nuts, dried, unblanched	✔	
Nuts and seeds	Pistachio nuts, dry roasted, without salt	✔	✔
Nuts and seeds	Pumpkin seed	✔	✔
Nuts and seeds	Cashew nuts, dry roasted, without salt	✔	✔
Nuts and seeds	Sunflower seed kernels, dried	✔	✔
Fats and oils	Butter, with salt	✔	✔
Fats and oils	Vegetable oil spread, 20% fat, with salt	✔	✔
Fats and oils	Coconut milk	✔	
Fats and oils	Coconut meat, desiccated	✔	✔
Fats and oils	Oil, olive, salad or cooking	✔	✔
Fats and oils	Oil, sunflower	✔	✔
Fats and oils	Oil, corn	✔	
Condiments	Sugars, powdered	✔	✔
Condiments	Honey	✔	✔
Condiments	Salt, table	✔	✔
Condiments	Tomatoes, red, ripe, canned, stewed	✔	✔
Condiments	Plums, dried (prunes)	✔	✔
Condiments	Apricots, dried, sulfured	✔	✔
Condiments	Raisins, seedless	✔	✔
Condiments	Mayonnaise, with olive oil	✔	✔
Condiments	Vinegar, red wine	✔	✔
Condiments	Pickles, cucumber, dill	✔	✔
Condiments	Peppers, sweet, green	✔	✔

Annex 2

RECOMMENDED INTAKES OF NUTRIENTS FOR THE FOUR MEMBERS OF THE REFERENCE FAMILY

Nutrient	Child 1 4–6 years	Child 2 7–9 years	Adult, male 31–50 years	Adult, female 31–50 years
Energy (MJ)	6.81	7.76	10.6	8.1
Energy (Kcal)	1 629	1 856	2 536	1 938
Protein (g)	19.0	27.3	56.0	47.0
Calcium (mg)	600	700	1 000	1 000
Iron (mg)	6.0	9.0	14	29
Magnesium (mg)	73	100	260	230
Phosphorus (mg)	450	450	550	550
Potassium (mg)	2 300	2 500	3 800	2 800
Sodium (mg)	300	400	460	460
Zinc (mg)	3.1	3.3	4.2	3.0
Copper (mg)	1.0	1.0	1.7	1.2
Manganese (mg)	2.5	2.5	5.5	5
Selenium (µg)	21	21	34	26
Vitamin C (mg)	30	35	45	45
Thiamine (mg)	0.6	0.9	1.2	1.1
Riboflavin (mg)	0.6	0.9	1.3	1.1
Niacin (mg)	8.0	12	16	14
Pantothenic acid (mg)	3.0	4.0	5.0	5.0
Vitamin B6 (mg)	0.6	1	1.3	1.3
Folate (µg)	200	330	400	400
Vitamin B12 (µg)	1.2	1.8	2.4	2.4
Vitamin A (RAE)	450	500	600	500
Vitamin E (mg)	5.0	7.0	10	7.5
Vitamin D (µg)	5.0	5.0	5.0	5.0
Vitamin K (µg)	20	25	65	55
Biotin (µg)	12	20	30	30
Iodine (µg)	110	100	130	110

Sources: UNHCR et al., 2003;[1] WHO, 2003b;[2] WHO, 2004.[3]

1 UNHCR, UNICEF, WFP, WHO (2003). Food and nutrition needs in emergencies. Geneva: World Health Organization (http://whqlibdoc.who.int/hq/2004/a83743.pdf, accessed 9 June 2015).

2 WHO (2003b). Diet, nutrition and the prevention of chronic diseases. Geneva: World Health Organization (WHO Technical Report Series: No. 916; http://whqlibdoc.who.int/trs/who_ trs_916.pdf, accessed 9 June 2015).

3 WHO (2004). Food and health in Europe: a new basis for action. Copenhagen: WHO Regional Office for Europe (WHO Regional Publications. European series: No. 96; http://www.euro.who.int/__data/assets/pdf_file/0005/74417/ E82161.pdf, accessed 9 June 2015).

Annex 3

DIETARY INTAKE GOALS: FOOD BASKETS ENSURING A HEALTH-PROMOTING EFFECT

Values are taken from Diet, nutrition and the prevention of chronic diseases (WHO, 2003b): ranges of population dietary intake goals.[1]

Dietary factor goal	Percentage of total energy (unless otherwise stated)
Total fat	15–30%
saturated fatty acids	<10%
polyunsaturated fatty acids	6–10%
n-6 polyunsaturated fatty acids	5–8%
n-3 polyunsaturated fatty acids	1–2%
trans-fatty acids	<1%
monounsaturated fatty acids	By difference[a]
Total carbohydrate	55–75%[b]
Free sugars[c]	<10%
Protein	10–15%[d]
Cholesterol	<300 mg per day
Sodium chloride	<5 g per day
(sodium)[e]	(<2 g per day)
Fruits and vegetables	>400 g per day
Total dietary fibre from foods[f]	>25 g/day

[a] Total fat calculated as: saturated fatty acids + monounsaturated acids + polyunsaturated fatty acids + trans-fatty acids + glycerol portion.
[b] The percentage of total energy in the food basket.
[c] The term "free sugars" refers to all monosaccharides and disaccharides, either added or naturally occurring in food or juices.
[d] WHO et al., 2002.[2]
[e] Salt should be iodized appropriately. The need to adjust salt iodization, depending on observed sodium intake and surveillance of iodine status of the population, should be recognized.
[f] Eighty percent of total dietary fibre is considered to consist of non-starch polysaccharides (WHO, 2003b, p. 58).[1]

[1] WHO (2003b). Diet, nutrition and the prevention of chronic diseases. Geneva: World Health Organization (WHO Technical Report Series: No. 916; http://whqlibdoc.who.int/trs/who_ trs_916.pdf, accessed 9 June 2015).
[2] FAO/WHO/UNU Expert Consultation on Protein and Amino Acid Requirements in Human Nutrition (2002). Geneva: World Health Organization (WHO Technical Report Series, No. 935; http://whqlibdoc.who.int/trs/who_trs_935_eng.pdf, accessed 9 June 2015).

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