WHO DIETARY NORMS: A QUANTITATIVE EVALUATION OF POTENTIAL CONSUMPTION IMPACTS IN THE UNITED STATES

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Contributed paper prepared for presentation at the International Association of Agricultural Economists Conference, Gold Coast, Australia, August 12-18, 2006

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Abstract

The member countries of the World Health Organization (WHO) have recently endorsed its Global Strategy on Diet, Physical Activity and Health in an effort to combat the growing burden of non-communicable diseases. We assess the potential consumption impacts of these norms in the United States using a mathematical programming approach. We find that adherence to the WHO norms would involve significant changes in diets, with large reductions in the consumption of fats and oils accompanying large rises in the consumption of fruits, vegetables and cereals. Further, intakes of sugar would have to shrink considerably to comply with the WHO norms. By focusing on sub-populations within the country, we find that education is the only socio-demographic variable exerting a consistent and significant influence on the required dietary adjustments. Income, among other variables, has little effect on required adjustment levels. This implies that the least educated, not necessarily the poorest, would have to bear the highest burden of adjustment; and that nutritional policy based on information provision and labelling might prove difficult while policy based on fiscal measures may not be as skewed against the poor as popularly believed.

***JEL Codes*:** Q18, C6, D1, I10, L66

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Introduction

In May 2004, the member-countries of the World Health Organization (WHO) endorsed its Global Strategy on Diet, Physical Activity and Health. The strategy document (WHO, 2004), adopted after considerable controversy and debate, calls for limiting the consumption of saturated fats, cholesterol, salt and sugars, and to increase consumption of fruit and vegetables in order to combat the growing burden of non-communicable diseases. The strategy is based on the report from a two year long joint WHO/FAO consultation that reviewed the available scientific evidence on the relationship of diet, nutrition and physical activity to chronic diseases (WHO, 2003). Specific, globally applicable, quantitative recommendations made in the report regarding desirable dietary composition thus form the basis of the WHO's global strategy to combat these chronic diseases.

Adherence to the dietary norms envisaged by the WHO is likely to involve major changes in the dietary and food habits for the population in most countries of the world. The precise nature and magnitude of dietary adjustments will depend on how the recommendations of the WHO are taken forward through legislative, regulatory or information measures in different countries. While enforcement of dietary norms is generally difficult, consumer choice can be influenced through fiscal measures (*e.g.*., fat taxes), recommendations of health authorities and labeling requirements that may be put in place. Further, major changes in consumption patterns are likely to have significant implications for the production and trade of food products, for the pattern of land use in agriculture and the environmental sustainability of food production. Understandably, producer associations and several sectors of the food industry have expressed serious concerns about the potential impact of the WHO norms on their future growth prospects[1]. Concerns have also been expressed at high political levels, notably in a letter written by William Steiger, Special Assistant to the Secretary of Health and Human Services, US Government, to WHO Director-General J.W. Lee[2].

However, little *quantitative* information is available on how adherence to these norms could potentially impact the consumption of specific food categories in various countries. This paper aims to contribute to this important debate by simulating such changes for the United States where the global food industry has a substantial stake and where current patterns of consumption are in significant violation of the proposed norms. It does so by applying a mathematical programming model to dietary survey data to derive 'optimal' food consumption vectors that satisfy all proposed WHO norms, and computing implied changes from the current baseline. In the process of deriving consumption change estimates, we are also able to shed light on whether particular demographic groups within the country, *e.g.* poorer or richer, or those with less or more education, are likely to bear the burden of adjustment. Such analysis based on broad demographic groupings has implications for 'targeting' of government policy in moving towards the norms – are there broadly identifiable groups towards whom information campaigns and policy measures should be concentrated? Finally, we are able to comment on the baseline nutritional status and adjustment patterns of different demographic groups.

WHO Dietary Intake Goals

The WHO dietary recommendations for combating chronic diseases specify the share of energy (calorie) intake that should be contributed by fats (and their various components), proteins and sugars. In addition they also prescribe certain absolute consumption levels for cholesterol, sodium chloride (salt) and fruits and vegetables. The range of population dietary intake goals contained in the WHO recommendations, which have emerged after a wide-ranging consultation, are summarised in Table-1 below. However, these recommendations have led to a vigorous debate on the appropriateness of these norms for a wide range of populations in different countries and the extent to which these recommendations are based on definitive/conclusive scientific evidence (see, e.g., FAO-COAG, 2004; Dyer, 2005; Margetts, 2003; Mann, 2003).

[Insert Table 1 here]

Note that in many nutrient categories, the US and most OECD countries already have nutritional targets closely corresponding to the WHO norms. In the US, the 'Dietary Guidelines for Americans' is the periodic document that forms the cornerstone for nutritional targets and policymaking. In its latest version (DHHS & USDA, 2005), the following targets are among those set out: total fat: less than 35% of energy intake; saturated fat: less than 10%; cholesterol: less than 300 mgs/day; sodium: less than 2.3 g/day.

However, the WHO norms set out in Table 1 are all at least as strict as these national targets, and for some categories, there are no specific national targets. In the US, the dietary guidelines document does not set out an explicit norm for sugar intake[3]. The WHO norms can thus be regarded as a stricter set of standards for countries to aspire to. They provide us with a common yardstick with which to evaluate the current situation, and the consumption changes that will be necessary to meet these long-run global aspirations.

Methodology Overview

We start by calculating the current nutritional status relative to the proposed WHO norms, and then estimate the dietary changes required to adhere to these norms. The WHO norms are expressed in terms of the nutrient and energy contents of diets and do not impose restrictions on the consumption of individual food items. Energy and nutrients are derived from a large number of food products and, therefore, a large number of diets that conform to the norms are theoretically possible. Estimating reformulations of diets in response to nutritional constraints, therefore, requires the construction of a model. We use a mathematical programming approach to predict the changes in food consumption most likely to occur if consumers were to adhere to the WHO/FAO norms. Given the persistence of dietary patterns and preferences, our analysis will assume that in adjusting their consumption of food products to adhere to these norms, consumers will prefer to modify their current diet as little as possible.

Linear programming (LP) has a long history in the analysis of human diets, going back to Stigler's (1945) analysis that minimized diet costs while meeting nutritional constraints. Since then, such LP models have been constructed for several countries and diet optimization problems (e.g., Smith, 1959; Henson, 1991). Alternatives to LP techniques include multiple-objective programming and goal programming, where several considerations relating to diets are optimized simultaneously. Another approach is that of quadratic programming (QP), where deviations from actual consumption levels are minimised while satisfying nutritional considerations. This approach is based on the paradigm that consumer preference and palatability considerations are manifested in the observed food choice. Radical changes from the observed choices are unrealistic, and hence deviations from the original diet are made as small as possible when estimating the new diet that meets the nutritional constraints. QP and LP have been used both in conjunction with price/cost constraints, as well as without. For example, the USDA's Thrifty Food Plan, a fundamental part of the US food guidance system, has been based on QP routines since 1975. A parallel literature has emerged that uses QP or LP methods, but abstracts from price/cost considerations, primarily due to unavailability of suitable data (*e.g.*., Gedrich, et. al., 1999; Darmon, Ferguson and Briend, 2002).

QP is the technique used in this study because of its intuitive appeal, described above, and its limited data requirements. In particular, the lack of availability of detailed information on food prices ruled out model specifications based on diet costs. However, there is some comfort to be taken in knowing that, since the new diet is chosen to deviate minimally from observed diets, the cost of the new diet is unlikely to stray radically from that of the observed one.

The first part of our QP model can be formally described as below:

$$\underset{x_i^{'}}{Min} \sum_{i \in F} \alpha_i \left(\frac{x_i^{'} - x_i}{x_i} \right)^2 , \text{where } \alpha_i = \frac{e_i x_i}{\sum_{i \in F} e_i x_i} \qquad (1)$$

The objective function (1) is the weighted sum of squared deviations between the components of the optimized diet x_i' and the observed one x_i. Deviations are expressed in percentage terms. This prevents an unnatural situation where items that are consumed in relatively small amounts at the baseline expand or contract in large percentage terms when the diet is reformulated. The weights α_i are the contributions of the food products to the original total energy intake, which are easily computed from the calorific coefficients e_i for each food item[4]. This objective function is minimized over the whole set F of food items originally consumed subject to several nutritional constraints. The first three constraints simply state, in accordance with the WHO norms, that energy from fat, protein and saturated fat should not exceed 30%, 15% and 10% of total calorific availability respectively:

$$9\sum_{i\in F} f_i x_i' \le 0.3\sum_{i\in F} e_i x_i' \qquad (2)$$

$$4\sum_{i\in F} p_i x_i' \le 0.15\sum_{i\in F} e_i x_i' \qquad (3)$$

$$9\sum_{i\in F} s_i x_i' \le 0.1\sum_{i\in F} e_i x_i' \qquad (4)$$

where f_i, p_i and s_i denote the conversion coefficients of food item i into fat, protein and saturated fat[5] respectively. The fourth constraint restricts Poly-Unsaturated Fatty Acids (PUFA) to a range of 6 to 10% of energy. Thus, where r_i is the PUFA conversion factor of food i,

$$0.06\sum_{i\in F} e_i x_i' \le 9\sum_{i\in F} r_i x_i' \le 0.1\sum_{i\in F} e_i x_i' \qquad (5)$$

Note that the requirements in Table 1 regarding mono-unsaturated fats and carbohydrates are met automatically (by difference) given the above constraints. The next constraint restricts energy availability from sugar to a maximum of 10% of total energy availability:

$$\sum_{i\in S} e_i x_i' \le 0.1\sum_{i\in F} e_i x_i' \qquad (6)$$

where *S* is the subset of *F* corresponding to sugar (centrifugal as well as non-centrifugal) as well as other sweeteners. The sixth constraint imposes a minimum daily per capita consumption of 400 grams of fruits and vegetables:

$$400 \le \sum_{i\in V} x_i' \qquad (7)$$

where V is the subset of food items that are either fruits or vegetables. The constraint restricting cholesterol intake to no more than 300 mg per day is given by:

$$\sum_{i\in F} c_i x_i' \le 300 \qquad (8)$$

where c_i represents the cholesterol content of food item i.

The model described above is applied first to average food consumption data aggregated at the national level, and then on the basis of aggregation based on demographic groupings. It is worth noting that constraints relating to Trans Fatty Acids (TFA) and sodium are not incorporated in the analysis. The TFA conversion factors are simply not available except for a limited number of food products. Sodium conversion information is also not available on a consistent basis. Thus caveats regarding non-inclusion of these two constraints must be kept in mind when interpreting results. Finally, note that an explicit fibre constraint is not included, since the WHO norms do not specify a particular quantitative fibre goal.

It is worth noting a key point concerning our analysis based on demographic groupings. The analysis is performed with the purely pragmatic objective of isolating broad demographic sub-groups for policy targeting, and does not control for other factors that may vary within a sub-group. For example, when dietary adjustments are computed for various income classes, education, ethnicity, age and other factors that may impinge on the diet-income relationship are not controlled for, in contrast to regression-based analyses of dietary outcomes. Yet, from a very practical policymaking perspective, broad groupings may be more valuable than relationships conditional on a long list of control factors. For instance, a policymaker could easily identify and focus on vulnerable groups if provided information that the poorest are likely to bear the burden of adjustment. In contrast, information that income exerts influence on dietary patterns provided age, race, schooling and other factors that may co-vary with income are held constant, may be less useful. This limitation of conditional regression analysis for the definition of optimal targeting rule has, in fact, been recognised in other areas, including the analysis of poverty (Ravallion, 1996) and that of tax and spending reform (Besley and Kanbur, 1993). Further, disaggregation by socio-economic category is also relevant from a methodological point of view because extrapolating from country-level averages may give rise to inaccuracies in estimated consumption changes as averages ignore the variability inherent in the distribution of food supplies in a country. For example, poorer classes as a sub-group may violate the total fat constraint while richer classes may not, leading to a ‘cancelling out’ effect when the total fat content of *average* food intake is computed. In this case, extrapolating from the average would lead to an underestimation of consumption changes needed to adhere to the norms.

Data

The US data used in simulations here are from the 2001-2002 round of the National Health and Nutrition Examination Survey (NHANES). The NHANES is the authoritative nationwide survey of health and nutrition profiles of US residents, and is coordinated by the Centre for Disease Control and Prevention (CDC), Department of Health and Human Services, US Government. The survey data are collected on an individual rather than a household basis, and the food consumption data are based upon 24 hour recall. After deletion of observations with missing values, data on 7470 individuals are used in analysis here. The food consumption data in NHANES are also directly linked to food composition data provided by USDA's Food and Nutrient Database for Dietary Studies (FNDDS), enabling convenient calculation of nutritional outcomes. Categorical information on income, ethnicity and education is also available that enables break down of the analysis on the basis of socio-economic information to examine the 'cancelling out' effect and targeting issues.

Results

Baseline Nutritional Status

Table 2 shows the baseline nutritional status calculated as national averages from the dataset, with violations of the WHO targets indicated in bold. As seen, average consumption in the US is in violation of the fat as well as the saturated fat constraints. However, these fat related violations appear small compared to violation of the sugar constraint. While the WHO norms require a maximum of 10% of energy intake derived from sugar, the baseline for the US average is 17.58%. The fruit and vegetable consumption at the baseline (269 grams per person per day) is also significantly distant from the target of 400 grams. Somewhat surprisingly, however, the cholesterol constraint is not violated. These baseline numbers suggest that the simulated dietary changes are likely to be driven largely by the sugar and fruit & vegetable constraints, with the fat constraints playing only a secondary role.

[Insert Table 2 here]

Simulation results for the US

Table 3 presents the results obtained from applying the simulation based on the overall sample mean and then extrapolating to the whole US population. As discussed earlier, while the total and saturated fat constraints are violated on average in the US, the sugar and the fruit and vegetable constraints are violated much more significantly. Thus the model simulates an 80% and a 37% increase in fruit and vegetable products consumption respectively, while predicting reductions of 75% and 62% for fats/oils and non-alcoholic beverages (predominantly, soft drinks and colas) respectively. Low fat, low-sugar, carbohydrate-rich products in the form of Breads and Flour (53%), Pasta and Rice (29%) and Other Cereals (29%) also expand significantly in the modified diet.

While much attention in dietary regime discussions is focused on meats, particularly red meats, our results show that adhering to WHO dietary norms would require relatively small changes in meat consumption for the US. Red meat and poultry meat consumption levels are predicted to fall by 9% and 3% respectively, with ‘other meats’ (game, offal, *etc.*) consumption substituting somewhat with a 2% increase. The Milk and Milk Products category is also relatively unaffected, rising by 2%. In this case, fluid milk, the largest constituent of this category, increases by 20%, which is not surprising given that US milk consumption is increasingly dominated by low fat and skimmed milk varieties. Higher fat milk products such as yogurts, cheeses and milky desserts are reduced significantly in the simulation, resulting in the overall category changing little as a whole. Of all animal product categories, only eggs and egg products consumption is predicted to diminish significantly (30%).

[Insert Table 3 here]

Results disaggregated by educational categories are presented in Table 4. The table reveals that for most product categories, although the direction of change is predominantly the same for all educational levels, the magnitude of change required decreases as educational attainment increases. This reflects the baseline differences in nutritional levels across educational categories. As seen before, the sugar and fruit/vegetable constraints are key for the US, while the fat constraints are not as important. At the baseline, fat outcomes are more or less the same across the three educational categories (33 to 34% in each case for total fat, and approximately 11% in each case for saturated fat). However, energy derived from sugar shows a decreasing trend with increased education – the sample average for those with less than high school education is 21%, for those with a high school diploma is 19%, and for those with education beyond high school is 17%. Similarly, fruit and vegetable consumption increases steadily with education in the sample (245 grams per day for the least educated, 281 for the high school level and 353 for the most educated). With the sugar and fruit/vegetable constraints driving the direction of the simulations for the most part, we get the observed result where the least educated have to make the largest adjustments. This education effect is consistent with the results of Popkin, Zizza and Siega-Riz (2003), who found education to be the one socioeconomic variable to display a clear and persistent effect on nutritional outcomes in the US.

[Insert Table 4 here]

The NHANES 2001-2002 survey provides information on the ethnic grouping of respondents in five categories: Caucasian, African-American, Mexican-American, Other Hispanic Origin and ‘Others’. Analysis broken down on the basis of these categories is presented in Table 5. Apart from one or two exceptions, the direction of change for each food category is the same across ethnic groupings. In terms of magnitudes, the only aspect that stands out is that the burden of change appears to be highest among African-Americans, while those in the ‘Other’ category (of which Asian-Americans constitute a significant proportion) will require the smallest changes to their diet. Again, this is consistent with the baseline intakes of the two categories driving the simulation results, sugar and fruits & vegetables.

Energy from sugar is highest among African Americans at 22%, while the other groups have values between 18 and 20%. Fruit and Vegetable consumption is also lowest among African Americans, at 261 grams per day, while the other group values range from 276 (Mexican-Americans) to 337 ('Others').

[Insert Table 5 here]

Income is the socio-demographic variable that researchers have most commonly attempted to link to nutrient intakes. However, Popkin, Zizza and Siega-Riz (2003) find that income fails to differentiate clearly between nutritional outcomes in the US, and Adelaja, Nayga and Wall (1997) find the income variable to be statistically insignificant in regressions explaining macro-nutrient intakes. Baseline nutrient intake comparison by income class in our NHANES sample also shows that there is no discernible, monotonic relationship between income and nutritional outcomes. Outcomes for the key drivers, sugar and fruits/vegetables, begin to show a slight improvement pattern only at higher income levels. Accordingly, our simulation results by income class, presented in Table 6, show that the adjustment burden is more or less equally distributed across income categories, only declining somewhat for the highest income class.

[Insert Table 6 here]

Finally, note that although our analysis by demographic groups does lead to some broad targeting/policy lessons (*i.e.,* focus on lower educated, and African-American groups), the cancelling-out effect has not occurred. Regardless of the demographic variable used to break down the analysis, all sub-groups had baseline nutritional outcomes on the same side of any relevant WHO constraint. Thus, the food product adjustment numbers aggregated up from the sub-categories (the last column in each of Tables 4, 5 and 6) is quite similar to the numbers derived based on the overall sample (Table 3).

Discussion And Conclusion

Summing Up

The previous analysis demonstrates that diets in the US would have to change substantially in order to comply with the WHO norms. The largest across-the-board implications are for the following food groups: fruits (80% expansion), vegetables (37% expansion) and fats and oils (contraction in the range of 75%). Somewhat surprisingly, the implications for meat consumption are relatively modest. The changes in the pattern of consumption of food products are, expectedly, driven by the violations of the sugar and fruit & vegetable norms. Most notably, compliance with the norms in the US would involve large reductions in consumption of sugar-rich products, such as soft drinks. Altogether, this analysis establishes that a move towards healthier diets in the US would have a major impact on the structure of food demand, with obviously important – although difficult to define precisely – implications for the pattern of agricultural production, trade and land use.

The disaggregated results further demonstrate that most socio-economic characteristics have relatively little influence on the pattern of adjustment necessary to comply with the norms. In particular, we find no relationship between household income and the magnitude of the simulated dietary changes. This confirms some results in the literature (Popkin, Zizza and Siega-Riz, 2003; Adelaja, Nayga and Wall, 1997) but contradicts others. For instance, Stewart and Harris review research on the determinants of vegetable consumption in the US to conclude that, altogether, higher-income households spend more on vegetables than their lower-income counterparts. Given that vegetable and fruit consumption in the US represents a key constraint to the achievements of the WHO dietary norms, one may have expected from this result a negative relationship between the magnitude of the simulated adjustment and household income – but that is not the case. Compared to many other studies, however, our approach presents the advantage of evaluating diets in their entirety, which allows us to establish that relatively poorer households adopt diets that are not significantly less healthy (as judged by the WHO norms yardstick) as those of relatively richer households.

It is found that the magnitude of the adjustment necessary to conform to the norms decreases with the level of education of the household head. The relationship is explained primarily by the different levels of consumption of fruits, vegetables and sugar-rich products across the classes of households distinguished by the educational level of the household head. This finding provides support for the argument proposed by previous authors (Carlson and Gould, 1994; Blisard, Variyam and Cromartie, 2003) that better-educated households are more nutritionally aware and, as a result, adopt relatively healthier diets.

This set of results has three major implications. First, the 'education-poor' will have a relatively large burden to bear in terms of adjustment. This poses a special challenge for any policy based on dietary recommendations and labelling requirements. Not only will the least educated have the largest adjustments to make, they will also be the most difficult group to induce change in. Recommendations and labelling policy may have to be complemented with strong educational campaigns. On the other hand, a lack of a strong relationship between the simulated adjustments and income implies that fiscal measures such as 'fat taxes' may not be as regressive as popularly believed[6]. Second, with education providing the only clear basis, targeting is likely to be difficult. Thus print media based campaigns may prove relatively fruitless, although television based communication may be more promising. Third, our analysis demonstrates that the magnitudes of the simulated changes in food consumption are remarkably similar whether based on population averages or disaggregations across various socio-demographic groups. Hence, there is little 'aggregation bias' in computing adjustments in diets and, at least for high-income economies, this suggests that it is appropriate to evaluate the impact of nutritional policies by relying on average (country-level) consumption figures.

WHO Guidelines and the Evolution of Agricultural Policy

Government intervention in agricultural markets remains extensive in most developed countries, but agricultural goods are not taxed uniformly. Consequently, agricultural policies affect relative prices of food commodities and diet composition in those countries. In light of our simulation results, we now ask what influence agricultural policies may have on nutritional outcomes and the satisfaction of WHO dietary norms. The analysis is based on the consumer support equivalent (CSE) estimates published by the OECD for all member countries (OECD, 2003)[7].

Table 7 presents the percentage CSEs for the OECD as a whole, the EU and the United States with respect to fourteen commodity groups. Focusing on the EU over the 2000-02 period, the commodities for which consumption is currently heavily taxed correspond to sugar, milk, beef and, to a lesser extent, pig meat. It is striking that, for the most part, these are the items for which our model simulates large declines in consumption in EU countries[8] as a way of conforming to the WHO norms. In the case of the U.S., sugar is one of the most heavily taxed items and our simulations suggest that sugar consumption should decrease substantially in order to conform to the norms.

[Insert Table 7 here]

Our results therefore suggest that policy makers in the E.U. and, to a lesser extent, the U.S., face an important dilemma. While the decoupling and phasing out of agricultural subsidies in those countries would undoubtedly result in increased resource efficiency, it would also modify relative food prices in a way that would encourage the consumption of commodities, which, from a nutritional point of view, are already consumed in excessive amounts[9]. Hence, our analysis reveals a certain degree of incompatibility between the goals of liberalising agricultural markets and that of promoting healthy eating patterns in EU countries and the U.S. This is so because current policy regimes tend to tax consumption of 'unhealthy' products, while this is not the case for vegetables, cereals and tubers.

Endnotes

[1] Some sections of the food industry have lobbied hard against the acceptance of the WHO norms and have attempted to question the scientific basis for these recommendations.

[2] A copy can be found at http://www.commercialalert.org/bushadmincomment.pdf

[3] Some US nutrition-related documents discuss a 25% of energy maximum intake for added sugars. However, this is still far in excess of the 10% WHO limit.

[4] In what follows, all quantities are expressed in grams per capita per day and energetic values in kcal.

[5] One gram of fat yields 9 calories of energy and one gram of protein 4 calories.

[6] Of course, it remains that, by virtue of Engel's law, if food is taxed, the poor will be impacted proportionally more than the rich. However, our results indicate that the burden imposed by a 'fat tax' on the poor is unlikely to be larger than that imposed on the rich when expressed as a proportion of total food expenditure. This is so because we find that the poor do not consume the 'unhealthy' products more likely to be taxed in greater amounts than the rich. More generally, much debate exists about the equity impact of health policies, as reviewed by Chaloupka and Warner (2000) for the particular case of smoking.

[7] The CSE is an indicator of the annual monetary value of gross transfers to consumers of agricultural commodities, measured at the farm gate level, arising from policy measures which support agriculture, regardless of their nature, objectives or impacts on consumption of farm products (OECD, 2003). For simplicity of interpretation, we only present the percentage CSEs that capture the implicit tax imposed on consumers of food commodities by agricultural policies.

[8] Simulation results for EU countries are not reported in this paper but are available from the authors.

[9] However, a counterargument can be put forward that the price elasticity of basic foodstuffs tends to be low.

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Table-1: Ranges of Population Dietary Intake Goals

Dietary factor	Goals
Total fat	15-30% energy
Saturated fatty acids	<10% energy
Polyunsaturated fatty acids (PUFAs)	6-10% energy
n-6 Polyunsaturated fatty acids (PUFAs)	5-8% energy
n-3 Polyunsaturated fatty acids (PUFAs)	1-2% energy
Transfatty acids	<1% energy
Monosaturated fatty acids (MUFAs)	By difference [a]
Total carbohydrate [b]	55-75% energy
Free sugars [c]	<10% energy
Protein	10-15% energy
Cholesterol	<300 mg/day
Sodium chloride (sodium)	<5 g/day
Fruits and vegetables	>= 400 g/day

[a] This means "total fat – (saturated fatty acids + polyunsaturated fatty acids + trans fatty acids)"
[b] The percentage of total energy available after taking into account that consumed as protein and fat, hence the wide range.
[c] The term "free sugars" refers to all monosaccharides and disaccharides added to foods by the manufacturer, cook or consumer, plus sugars naturally present in honey syrups and fruit juices.
Source: (WHO: 2003)

Table 2: Baseline Nutritional Status in the US

	US	TARGET
Calories (kcal)	2165.2	
Fat % of energy	**33.3%**	15 to 30%
Protein % of energy	14.3%	10 to 15%
Sat. fat % of energy	**11.0%**	< 10%
PUFA % of energy	6.6%	6 to 10%
Sugar % of energy	**17.6%**	< 10%
Cholesterol (mg)	274.4	< 300
Fruit & Veg. (grams)	**269.0**	> 400

Table 3: Percentage Change in Food Consumption, Whole US Population

Food category	% Change
Breads and Flour	53
Cakes & Confectionery	-12
Egg & Egg Products	-30
Fats and Oils	-75
Fish	8
Fruits and Fruit Products	80
Legumes & Nuts	19
Milk and Milk Products	2
Other Cereals	29
Other Meat	2
Pasta & Rice	29
Potatoes & Starchy Veg	18
Poultry Meat	-3
Red Meat	-9
Non-Alcoholic Beverages	-62
Sugars & Sweeteners	-43
Vegetables & Vegetable Products	37

Table 4: Percentage Change in Food Consumption by Educational Attainment (US)

Food Category	Less than High School	High School Diploma	More than High School	Aggregated
Breads and Flour	63	54	41	49
Cakes & Confectionery	-13	-9	-7	-9
Egg & Egg Products	-37	-30	-26	-29
Fats and Oils	-83	-70	-46	-56
Fish	8	6	-2	2
Fruits and Fruit Products	94	84	63	73
Legumes & Nuts	25	21	10	15
Milk and Milk Products	-2	3	2	1
Other Cereals	32	35	25	29
Other Meat	3	-1	-2	-1
Pasta & Rice	33	31	24	28
Potatoes & Starchy Veg	15	22	21	20
Poultry Meat	-4	-5	-10	-7
Red Meat	-11	-13	-17	-14
Soft Drinks	-63	-61	-58	-60
Sugars & Sweeteners	-48	-41	-36	-40
Vegetables & Veg. Products	48	35	26	31

Table 5: Percentage Change in Food Consumption According to Ethnicity (US)

Food Category	Mexican-American	Other Hisp. Origin	Caucasian	African-American	Other	Aggregated
Breads and Flour	48	43	49	71	35	53
Cakes & Confectionery	-16	-16	-6	-12	-9	-12
Egg & Egg Products	-35	-21	-26	-41	-14	-30
Fats and Oils	-80	-63	-51	-86	-39	-75
Fish	16	0	4	6	6	8
Fruits and Fruit Products	70	64	73	116	49	80
Legumes & Nuts	19	17	14	33	10	19
Milk and Milk Products	-5	-6	4	-6	-2	2
Other Cereals	30	19	27	38	10	29
Other Meat	7	3	-1	-6	5	2
Pasta & Rice	19	26	27	44	27	29
Potatoes & Starchy Veg	7	19	26	17	11	18
Poultry Meat	-2	4	-5	-7	-4	-3
Red Meat	-14	-4	-13	-11	-5	-9
Soft Drinks	-53	-61	-74	-62	-55	-62
Sugars & Sweeteners	-40	-40	-43	-47	-42	37
Vegetables & Veg. Products	34	35	34	52	22	35

Table 6: Percentage Change in Food Consumption According to Annual Household Income (US)

Food Category	< $10K	$10k - 20k	$20k-35k	$35k - 55k	$55k - 75k	> $75k	Aggregated
Breads and Flour	55	53	54	58	57	46	54
Cakes & Confectionery	-15	-16	-16	-12	-9	-6	-11
Egg & Egg Products	-37	-35	-31	-34	-29	-25	-31
Fats and Oils	-87	-77	-87	-72	-70	-56	-71
Fish	2	9	4	16	12	4	8
Fruits and Fruit Juice	81	81	82	84	86	69	80
Legumes & Nuts	17	22	22	19	15	13	18
Milk and Milk Products	-3	-3	0	2	1	4	1
Other Cereals	32	32	32	31	30	23	29
Other Meat	5	2	4	3	4	-2	2
Pasta & Rice	35	31	29	33	32	25	30
Potatoes & Starchy Veg	19	16	18	21	21	19	19
Poultry Meat	-4	-3	-3	-4	-4	-6	-4
Red Meat	-9	-9	-7	-8	-11	-12	-9
Soft Drinks	-61	-61	-61	-62	-65	-61	-62
Sugars & Sweeteners	-42	-40	-45	-46	-45	-41	-43
Vegetables	38	35	39	38	43	31	37

Table 7: Percentage Consumer Support Equivalents

Commodity	Period	OECD	EU	USA
Wheat	1986-88	-31	-33	3
	2000-2002	-7	-2	22
Maize	1986-88	3	-9	14
	2000-2002	11	-1	22
Other Grains	1986-88	-20	-13	3
	2000-2002	-16	-1	20
Rice	1986-88	-79	-58	15
	2000-2002	-80	-17	26
Oilseeds	1986-88	-3	1	2
	2000-2002	-1	0	4
Refined sugar	1986-88	-62	-72	-65
	2000-2002	-52	-53	-58
Milk	1986-88	-58	-59	-54
	2000-2002	-43	-40	-35
Beef and veal	1986-88	-26	-54	5
	2000-2002	-20	-59	10
Pig meat	1986-88	-21	-27	10
	2000-2002	-17	-22	23
Sheep meat	1986-88	-53	-64	-1
	2000-2002	-12	-15	-9
Poultry	1986-88	-21	-44	-1
	2000-2002	-11	-36	10
Eggs	1986-88	-17	-19	1
	2000-2002	-6	-2	10
Other Commodities	1986-88	-33	-40	-6
	2000-2002	-23	-23	3

Source: OECD, 2003