Dietary recommendations, goals and guidelines for health

in Saudi Arabia

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Abstract

The recent changes in life-styles and dietary habits toward the affluent diet, characteristically high in fat especially saturated fat, animal protein, sugar and a relatively low in complex carbohydrate, have caused imbalance of nutrients, resulting various forms of malnutrition and diet related chronic diseases in Saudi Arabia. Changing the national diet and maintaining appropriate patterns of nutrient intake to be achieved by a public-health prevention strategy by means of dietary recommendations, are desirable for maximum health benefits. The dietary recommendations including dietary allowances, desirable dietary pattern, to be achieved by the year 2005, nutritional goals and dietary guidelines to promote overall health of general public as well as vulnerable individuals and to reduce the risk of chronic degenerative diseases are suggested. To implement these recommendations and to make the population aware of the link between diet and disease, a close collaboration among the ministries of agriculture, health and education, food industry, educational institutions, mass media, and the general public is required. The dietary recommendations for promoting appropriate diets and life styles for Saudi Arabia may be adopted in other member states of the Gulf Cooperation Council.

Introduction

Dietary patterns have varied over time depending on agricultural practices, industrial revolution and socioeconomic development that changed the availability of food and nutritional composition of the diet in Saudi Arabia. The changes in the dietary pattern during the short span of two decades in the Kingdom [1] mimic a transition that took 137 years in Japan and 200 years in the United Kingdom [2]. Such rapid changes in lifestyles and dietary habits toward the affluent diet, may cause imbalance of nutrients [3], effect the quality of the diet [4] and have been correlated with increased risks of various chronic diseases [2]. A balanced diet is not the only component of a healthy lifestyle but other policies concerning smoking, physical activity and alcohol consumption are also related to health promotion. Excessive and unbalanced diets in Saudi Arabia [5] as indicated by the average consumption (per capita per day) of energy (3028 kcal), protein (15% of calories), fat (42% of calories) and carbohydrates (43% of calories), may be associated with the emergence of chronic degenerative diseases particularly obesity [6-8], hypertension [5,9,10], non-insulin-dependent diabetes mellitus [8, 11-13], cardiovascular diseases [8,14-17], various forms of cancers [18, 19], dental caries [5], gallstones [20,21] and other forms of malnutrition in the Kingdom [5,22].

The World Declaration and Plan of Action for Nutrition includes "promoting appropriate diets and healthy lifestyles" was adopted during the International Conference on Nutrition convened by FAO and WHO in Rome in

December 1992 [23]. A Joint FAO/WHO Consultation [24] recommended the scientific basis for the preparation and use of food-based dietary guidelines (FBDGs) to achieve these objectives. A number of countries and organizations have developed dietary patterns/goals/guidelines for policy-makers or practitioners in agriculture or health or for the general public [4, 24-28]. Dietary goals/guidelines to improve the food consumption patterns and nutritional well-being of individuals and populations do not exist in Saudi Arabia. Since most chronic diseases etiologically linked with nutritional factors affect the general population, the most benefit of reducing chronic disease risk, is likely to be achieved by a public-health prevention strategy by means of dietary recommendations. An attempt to develop dietary recommendations including dietary allowances, desirable dietary patterns, goals and guidelines for health in Saudi Arabia has been made in this paper.

Recommended dietary allowances (RDAs)

The RDAs for energy and protein for Saudis (Table 1), to maintain a good state of nutrition in healthy people of all ages, have been developed [29]. The RDAs are intended as a guide in catering, in institutional feeding, in planning food production and imports and in assessing the adequacy of the average diet in food consumption surveys. RDAs apply to healthy persons. However, they do not cover special nutritional needs arising from metabolic disorders,

chronic diseases, injuries, premature births or other medical conditions and drug therapies.

The per capita requirements of energy and protein (NPU 0.8) at national level are 2100 Kcal per day and 53 g per day respectively. The average per capita energy requirements of Saudi male and female populations are 2290 kcal per day and 1870 kcal per day respectively. The daily energy requirements for Saudi reference man (65 kg) and reference woman (56 kg), engaged in light, moderate and heavy physical activity are calculated to be 2595 and 2050 kcal per day, 2975 and 2150 kcal per day and 3515 and 2400 kcal per day respectively. The recommended allowance for protein (NPU 0.8) for Saudi adult men and women is 1 g/kg body weight per person per day. The protein energy ratio expressed as the percentage energy derived from protein (PE%) has been used as an index of dietary quality. The ratio of protein requirements expressed as the ratio of protein-calories of the energy requirement (PE%) for different age/sex groups in Saudi Arabia ranges from 6% to 12% [29]. A comparison of this PE% value with the PE% of Saudi diet indicates that the quality of the diet in terms of protein was adequate for all different age groups [1, 29]. The dietary allowances of vitamins (Table 2) and minerals (Table 3) for Saudis were derived from the latest international RDAs [2, 24, 25, 29, 30].

Dietary pattern

The desirable dietary pattern in terms of food groups, to meet the nutritional requirements not only from the point of view of nutrients but also from stand point of bulk and palatability at national level have been developed according to FAO [31]. Such dietary pattern can guide the food and agriculture planners in diversifying food crops and deciding policies of food import and export. Some countries such as Australia, Japan, Newzeland, India and Pakistan have already made recommendations for developing dietary pattern in terms of food groups [4, 31, 32].

Food availability from various food groups in Saudi Arabia in terms of calories per capita per day as average for the years 1993-95, compared with FAO desirable levels [31] and the nutritive value of the diet are shown in Table 4.

Plant foods

Cereals constitute the main staple of Saudi diet and provide 50% of the total available calories. However, the consumption was 171% of the desirable level during this period (Table 4). Pulses and beans play an important role in improving the nutritive value of the diet rich in cereals. The calories from pulses and beans were low and were 22% of the desirable level. Nutritionally cereals and pulses are complementary [33, 34]. Cereals and pulses provide not

only the principal source of starch but also provide useful fibre in preventing constipation, diabetes and hyper cholestrolemia. Resistant starch in plant foods also acts like dietary fibre and may reduce the risk of cancer [35]. The calories from roots and tubers and nuts and oils seeds were 29% and 23% of the desirable levels respectively. Vegetables and fruits are nutritionally desirable and have protective role in preventing stroke and the development of cancers. These are relatively low in energy but high in fibre, vitamins and minerals. The consumption of calories from vegetables and fruits was very high and provided 307% of the desirable level (Table 4). However, vegetables and fruits are consumed only by 38% and 40% respectively of the Saudis across the country on daily basis [5]. Although the consumption of dates (per head per day) has decreased (28%) in the last two decades, yet 54% of the population consumed it daily [5]. An intake (per capita) of 400 g/day of vegetables and fruits is considered desirable to prevent coronary heart disease and some types of cancers [2].

The fats and oils provide calorie concentration, vehicles for fat soluble vitamins and supply essential fatty acids in the diet. Total fat intake per head per day was 145g containing 72% animal fat and contributing 42% of the total energy intake [5]. However, according to food balance sheets, these foods contributed high calories in the diet and were 172% of the desirable level (Table 4). There is clear evidence that amount and type of fat in the diet

influence the risk of atherosclerotic cardiovascular diseases [36], obesity [37] gallbladder disease [38] and certain forms of cancer [39]. Low fat diets are often lower in cholesterol and higher in antioxidants and dietary fibre. Among adults, there is no nutritional advantage to consuming high fat diets once essential energy and nutrient needs are met. Thus reducing total fat and saturated fatty acids intake is likely to lower the rates of these chronic diseases. Fat intake should be reduced by curtailing the major sources of dietary fats rather than by eliminating whole categories of foods, e.g. by substituting fish, skinless poultry, lean meats and low or nonfat dairy products for high fat food. Dietary fat can also be reduced by limiting intake of fried foods, baked goods containing high levels of fat and spreads and dressing containing fats and oils.

Sweets of various types and honey are consumed by 30% and 50% of the Saudi population respectively, 1-3 times a week [5]. Sugar increases the palatability and energy density of the diet. Excessive consumption of sugar is nutritionally undesirable and causes not only the incidence of dental caries and degenerative diseases [40] but also affects the utilization of dietary protein [41, 42]. It is evident (Table 4) that the consumption of sugar and honey was very high and contributed calories 194% of the desirable level during 1993-95. It has been claimed that juvenile delinquency as well as aggressive, antisocial and even criminal behaviour can result from reactive or postprandial hypoglycemia following the ingestion of sucrose and other carbohydrates [43].

Total sugar intake is commonly inversely related to total fat intake [44]. Although the consumption of Arabian coffee with cardamom and tea (per head per day) in the Kingdom has decreased (49%) from 5.7 g in 1987-89 to 2.9 g in 1993-95, yet 55% of the population consumed coffee on a daily basis [5]. However, positive association between death from breast, pancreatic, colon and bladder cancer and coffee consumption has been reported [45]. Diets high in plant foods have been associated with a reduced risk of several chronic diseases especially obesity, coronary heart disease, certain cancers, hypertension and diabetes [45].

Animal Products

The addition of animal products improves the caloric density, quality of protein and palatability of the diets. The availability of calories from total animal products was 72% of the desirable level over the period (Table 4). According to national nutritional survey [5], the average intake (per head per day) of meat and dairy products were 245 g and 370 ml respectively. The consumption of mutton on daily basis, camel meat 2-3 times per week, chicken 1-3 times per week, fish 1-3 times per week and milk and milk products daily by 80%, 20%, 40%, 29% and 60% respectively of the Saudi population has been reported [5]. Most of the Saudis (88% of urban and 86% of Bedouins) has a limited capacity to digest and absorb a large lactose load [25], yet it may be possible to tolerate a glass of milk – an excellent source of high quality

protein, calcium and riboflavin. However population may safely consume lactase containing fermented milk products. Diets high in meat have a strong positive association with increase coronary heart disease [46], certain cancers notably breast, colon and pancreatic cancer [47] and high protein diet can lead to glomerular sclerosis [48] and osteoporosis in the general populations [49]. However, the data linking elevated intakes of animal protein to increased risk of hypertension and stroke are weak [45]. Data from national food balance sheets and vital statistics show positive of CHD deaths with eggs, meat, milk, sugar and coffee and negative correlation for flour [47]. The growing body of scientific evidence, supporting the relationship between dietary patterns and health suggests that dietary score may be more useful than nutrient scores in the development of dietary guidelines.

Nutritive value of dietary pattern

The level of total dietary energy intake is the most important determinant of nutritional adequacy (Table 4). The recommended dietary energy allowances (RDA) for Saudi Arabia is 2100 calories per capita per day [29]. However, there is always a calorie loss of 10% between availability and consumption [50]. The addition of 10% to the present availability level would make the requirement 2310 calories. Table 4 showed that the availability of calories during 1993-95 in the Kingdom was 135% of the national requirement. The diet provided 10% of the total energy from protein, 23% form fat and 67%

from carbohydrates and met the nutritional goals recommended for a balanced diet at national level. The dietary score of this diet, based on FAO scoring pattern [31] was 90 and was similar to dietary scores of 90, 87 and 89 of national diets available in Australia, Japan and Newzealand respectively [31]. The dietary score of Saudi diet can further be improved by decreasing fats, sugars, vegetables and fruits while increasing pulses, beans and potatoes in the national diet.

Desirable dietary pattern

The desirable dietary pattern for Saudi Arabia, based on FAO desirable levels of various food groups for balanced diet [31] with a dietary score of 100, to be achieved by the year 2005, have been worked out (Table 5) according to Khan [4]. The levels of food groups have been expressed as kg per person per year for ease in their practical use in food policy and agriculture planning. There are several computations and permutations of food groups to achieve the same dietary score according to the availability of food groups. Other factors such as socio-economic, cultural and palatability and sufficient caloric density of the diet should also be considered in the selection of various food groups. The following goals were kept in mind for developing the desirable dietary patterns.

- Energy derived from cereals to be not more than 46% of total requirement.

- Energy derived from pulses and beans should be kept to 5% of the total calories.
- Energy derived from roots and tubers has been kept 3% of the total calories.
- Energy from vegetables and fruits not to exceed 5% of the total calories.
- Energy derived from total animal products has been kept at 20% of the total energy requirements.
- Energy derived from fats and oils not to exceed 10% of the total calories.
- Energy derived from sugar and honey not to exceed 8% of the total calories.
- The desirable dietary pattern provides 12% of the total energy from protein (animal protein 45%), 25% from fat and 63% from carbohydrates and meets the requirement of a balanced diet.]

The average national food basket per person per year at production level (Table 5) be composed of 122 kg of cereals, 16 kg of pulses and beans, 24 kg of roots and tubers, 82 kg of vegetables and fruits, 136 kg of animal products, 12 kg of fats and oils, 7 kg of nuts and oilseeds, 19 kg of sugar/honey and 12 kg of beverages etc. to achieve the dietary requirement at physiological level. It must be pointed out that the estimated production of foods can adequately meet the requirements at national level provided distribution of food is done according to requirements and constraints of purchasing power do not limit consumption.

Nutritional goals

Quantitative nutritional goals aim to provide nutritional recommendations that can be applied to national planning to promote overall health, control nutritional deficiencies or excesses, and reduce the risk of diet related diseases. Dietary goals are intended for policy-makers in developing dietary guidelines. Various study groups of FAO and WHO have proposed quantitative population nutrient goals expressed as ranges [2, 24]. The concept of nutrient requirements as nutrient density per 1000 kcal has been developed as a way of defining the adequacy of a given diet to meet the needs for specific nutrients if sufficient energy is consumed [24]. The concept is especially useful when energy intake is low, and it is essential that nutrient – dense foods be included in the diet. The nutrient densities with some modifications for selected nutrients relevant to developing dietary patterns or guidelines that meet the needs of Saudi family are given in Table 6.

Energy

Nutritional goals to prevent the social and pathological consequences of both energy deficit and excess are important. Good health involves the maintenance of appropriate weight and level of physical activity is important for inactive and sedentary lifestyle to avert several adverse consequences for health. The desirable body weights (BM1) for Saudi adult man and women are reported to be 22.4 and 22.1 respectively [29]. A population has to have

average value of about 22 to allow almost all the individuals to fall within 20-25 BMI range. The mortality and morbidity tend to increase as the BMI increases above 25 or drops below 18.5. Diabetes type II and breast cancer are almost non-existent in individuals with BMI of 20 or less [45]. Energy densities for pre-school children: 0.6 – 0.8 kcal/ml for liquid foods, 2 kcal/g for solid foods, for older children and adults: 1.5 – 2.5 kcal/g and for obese less than 1 kcal/g are desirable.

Protein

The protein requirement (Table 1) per kg body weight is 1.0 g after adjusting for protein quality of Saudi diet. The Saudi diet contributes animal protein more than 50% of the total protein [5]. The digestibility and net protein utilization (NPU) values of Saudi diet are reported to be 94% and 0.8 respectively and is similar to diets consumed in industrialized countries [1]. Such diets should provide 10-12% of total energy as protein. The animal protein should be less than 50% of the dietary protein.

Fat

In general, adults should derive at least 15% of their energy from dietary fats and oils, women of childbearing age should consume at least 20%. Infants fed breast milk or formula usually receive 50-60% of their total energy intake from fat. During the complementary feeding period up to 2 years of age – the

diet should provide 30-40% of energy from fat [24]. In countries like Saudi Arabia with rising affluence coronary heart disease mortality increases significantly as the percent of fat calories approaches 25, moreover, countries with low coronary heart disease and less breast cancer rates generally have diets that contain less than 25% of calories as fat [25]. Diets supplying 11-15% of calories as fat were adequate to meet the essential fatty acids requirement [2, 51]. The recommendations of total fat intake between 15% and 25% of energy, saturated fatty acids up to 10% of energy, polyunsaturated fatty acids, 3-7% of energy and cholesterol less than 300 mg/day are desirable for Saudi population. The use of liquid oils rather than hard fats which have higher content of saturated and transfatty acids should be encouraged.

Carbohydrates

Carbohydrates are the main source of energy in the diet for most people. Total carbohydrates, complex carbohydrates and sucrose should provide 55-75%, 50-70% and 10% respectively of dietary energy [2].

Micronutrients

Micronutrient deficiencies such as iron-deficiency anemia, iodine deficiency disorders, vitamin A and D deficiencies are common in most Arab countries [52]. The proposed nutrient densities for the family diet depend on the consumption of adequate amounts of energy for adults and adolescents. If

intake for adolescents or adults under 2000 kcal per day, it is unlikely that their vitamin and mineral needs will be met. Interactions among micronutrients, as well as other food components affecting their absorption, availability or excretion, are of great importance. The phytate and oxalates in plant foods reduce the availability of calcium. Decreased availability of iron from foods rich in tannins or through excess of calcium and the effect of dietary phytate from whole grain cereals and pulses restricting the utilization of iron, zinc and possibly magnesium and calcium. On the other hand, absorption of non-heme iron is enhanced by increasing the animal foods and vitamin C content of the diet. Fortification of staple foods such as wheat flour, sugar or salt has been successfully implemented in various countries to help prevent iron deficiency. Iodine fortified salt is available in the Kingdom and is the most effective way of eradicating the deficit. The scientific evidence supporting an important role for vitamins in promoting health and preventing noncommunicable diseases is currently receiving considerable attention. The population should ensure adequate consumption of vegetables and fruits or appropriate fortified foods rich in vitamin A to promote growth, prevent night blindness and inhibiting effect of polyphenols and phytates on iron absorption and strengthen immune function, vitamin D to promote bone health and to reduce the risk of osteoporotic fractures in elderly, antioxidant nutrients (vitamin C and E and β-carotene) and certain B vitamins (vitamins B_6, B_{12} and folate) to reduce risk of cardiovascular and cerebrovascular diseases and some forms of cancer [24].

Food-based dietary guidelines (FBDGs)

These are sets of advisory statements of helping population achieve a state of optimal nutrition which is conducive to good health. These are intended to help individuals consume diets that can alleviate health problems. FBDGs are intended to provide nutrition education and dietary guidelines for general public in terms that are scientifically sound, short, simple and understandable to most consumers. These must be communicated to the public through a variety of educated and motivated media. FBDGs should be consistent with the national agricultural policies for improved supplies and nutrition, health policies for reducing disparities in health services and nutritional status and educational policies for promoting healthy diet and lifestyles. For dietary guidelines to be followed, the range of foods available should be nutritionally adequate, of good quality and should be accessible to and affordable by the target population. To implement these guidelines, there is need a close collaboration among government agencies, food industry, institutions, mass media and the general public. The following dietary guideline to promote good health in general or to lower the risk of chronic diseases are recommended.

- Maintain appropriate body weight, increase physical activity and reduce smoking.
- Eat a nutritionally adequate diet composed of a variety of foods and drink more water.

- Reduce intake of total fat particularly saturated fat (butter, ghee, meat/skin fat).
- Eat more whole grain cereals, pulses and beans, potatoes vegetables and fruits.
- Eat only a moderate amount of sugar and foods containing added sugars.
- Eat moderately lean meat, organ meat, eggs, fish, chicken (no skin), milk and milk products.
- Reduce salt intake (minimal use of salty foods, processed foods, salt preserved and salt-pickled foods).

Dietary guidelines for special groups

Infants and preschool children

Infants should be exclusively breast fed for the first 4-6 months and breast feeding should be continued for up to 2 years as prescribed in the Holy Koran, while receiving nutritionally adequate and safe complementary foods after 4-6 months. If the breast milk is not available, cow's milk by diluting with water and adding sugar or oil may be used as infant formula. According to Khan et al [53] the fatty acid pattern of commercial infant formulas differed considerably from human milk and low protein quality reflected the deficiency of amino acids may be due to processing techniques or storage conditions. An adequate energy and nutrient density of the complementary foods is important to achieve full potential for growth and development and to prevent nutritional deficiencies such as protein-energy malnutrition, iron, deficiency anemia and

rickets in preschool children. Since most of the commercial weaning foods are nutritionally imbalanced [54, 55], home-made high energy weaning foods such as Mahlabiyeh or a thick porridge with some unsaturated oil or fat added are recommended. Introduction of baby foods fortified with iron and vitamin D are very important. The children should also be exposed to sun. The morbitity and mortality from diarrhea and acute respiratory diseases in preschool children and from diabetes, cardiovascular and other chronic diseases in later life can be prevented by good hygiene, proper feeding practices, regular exercise and nutrition education.

Adolescents

Adolescence is one of the most challenging periods in human development. Because of rapid growth, adolescents require more energy and other nutrients. Teenagers usually miss their meals at home and develop the habit of snacking and the excessive use of fast foods, influencing their nutritional well-being. The need to include fresh vegetables, fruits, beans, whole grain and milk products, to complement the foods high in energy and protein, eaten away from home should be emphasized, to meet the high requirements for iron, calcium and other minerals and vitamins.

Pregnant and lactating mothers

Because of high requirements for energy and nutrients, pregnancy and lactation demand the consumption of an adequate and balanced diet with emphasis on energy dense foods, foods of animal origin rich in protein, iron and calcium and consumption of fruits and vegetables. The drinking of tea and coffee with meals should be avoided.

Conclusions

The balance of macronutrients in Saudi diet is inappropriate and is a major contributing cause of chronic degenerative diseases. There is concern that these diseases will increase among young and elderly segments of the population. The relationship between certain dietary patterns and chronic diseases supports a comprehensive effort to educate the public about the risk and the benefits of dietary modifications and the use of technological and other means to facilitate changes in diet and lifestyle. Implementation of recommended desirable dietary patterns, nutritional goals and guideline will promote good health and lower the risk of chronic diseases. The role of environmental and agricultural sciences in developing and implementing dietary guidelines needs to be recognized. The local food industry should be encouraged to develop processing techniques that do not add fat, sugar or salt to food products. The dietary recommendation to promote appropriate diets and healthy lifestyles for Saudi Arabia may be adopted in other member states

of the Gulf Cooperation Council. The international agencies such as FAO and WHO should assist governments in developing, implementing and monitoring FBDGs.

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Table 1 Recommended dietary energy and protein allowances for Saudis

Category	Weight (kg)	Energy (kcal) per kg	Energy (kcal) per day	Protein (g)[a] per kg	Protein (g)[a] per day
Infants					
0-6 m	6	108	650	2.2	13*
6-12 m	9	98	880	1.6	14*
Children					
1-3 y	13	102	1300	1.5	20
4-6 y	20	90	1800	1.4	28
7-9 y	24	77	1850	1.3	31
Males					
10-12 y	33	64	2100	1.3	43
13-15 y	47	51	2400	1.3	61
16-17 y	59	45	2700	1.1	65
Females					
10-12 y	34	55	1900	1.3	44
13-15 y	49	43	2100	1.1	54
16-17 y	56	39	2200	1.0	56
Adult men					
18-29 y	65	43	2800	1.0	65
30-59 y	65	42	2700	1.0	65
60+ y	65	32	2100	1.0	65
Adult women					
18-29 y	56	37	2100	1.0	56
30-59 y	56	36	2000	1.0	56
60+ y	56	32	1800	1.0	56
Pregnant			+300		+8
Lactating					
0-6 m			+500		+20
6-12 m			+500		+15

[a]Net protein utilization = 0.8 y = year m = months
*Reference protein

Source: Khan and Al-Kanhal [29]

Table 2 Recommended dietary allowances of vitamins

Age (years)	Vitamin A (μg RE)	Vitamin D (μg)	Vitamin E (mg)	Vitamin K (μg)	Vitamin C (mg)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)	Vitamin B_6 (mg)	Vitamin B_{12} (μg)	Folate (μg)
0.5-1	350	10	3	10	30	0.4	0.5	5	0.5	0.4	30
1-3	400	10	5	15	35	0.6	0.8	8	0.8	0.6	50
4-6	400	10	6	20	40	0.9	1.1	11	1.1	0.9	70
7-9	400	5	7	25	45	0.9	1.1	11	1.1	0.9	100
Males											
10-12	500	5	7	35	50	1.1	1.3	13	13	1.1	150
13-15	600	5	8	50	60	1.2	1.4	14	1.4	1.2	150
16-17	600	5	10	60	60	1.4	1.6	16	1.6	1.4	150
Females											
10-12	500	5	7	35	50	1.0	1.1	11	1.1	1.0	150
13-15	600	5	7	50	60	1.1	1.3	13	1.3	1.1	150
16-17	600	5	8	55	60	1.1	1.3	13	1.3	1.1	150
Adult men											
18-29	600	5	10	65	60	1.4	1.7	17	1.7	1.4	200
30-59	600	5	10	65	60	1.3	1.6	16	1.6	1.3	200
60 +	600	5	7	65	60	1.1	1.3	13	1.3	1.1	200
Adult Women											
18-29	500	5	7	56	60	1.1	1.3	13	1.3	1.1	200
30-59	500	5	7	56	60	1.0	1.2	12	1.2	1.0	200
60 +	500	5	6	56	60	0.9	1.1	11	1.1	0.9	200
Pregnant	600	10	9	65	70	1.2	1.4	14	1.4	1.4	360
Lactating	850	10	10	65	90	1.3	1.6	16	1.6	1.3	270

Table 3 Recommended dietary allowances of minerals

Age (years)	Calcium (mg)	Phosphorus (mg)	Magnesium (mg)	Iron (mg)	Zinc (mg)	Fluoride (mg)	Iodine (μg)	Selenium (μg)	Chromium (μg)
0.5-1	450	350	50	10	6	0.6	50	12	40
1-3	650	500	60	15	8	0.9	70	20	50
4-6	850	775	80	20	11	1.3	90	25	75
7-9	850	900	120	20	11	1.3	120	25	120
Males									
10-12	1050	1050	170	22	13	1.5	150	32	125
13-15	1200	1175	270	22	14	1.7	150	36	125
16-17	1350	1200	400	22	16	1.9	150	40	125
Females									
10-12	950	1000	280	25	12	1.3	150	28	125
13-15	1050	1075	280	25	13	1.5	150	32	125
16-17	1100	1200	300	25	13	1.5	150	32	125
Adult men									
18-29	1200	1200	350	22	17	2.0	150	40	150
30-59	800	800	350	22	16	1.9	150	40	150
60 +	800	800	350	20	13	1.5	150	40	150
Adult Women									
18-29	1200	1200	280	25	13	1.5	150	30	150
30-59	800	800	280	25	12	1.4	150	30	150
60 +	800	800	280	20	11	1.3	150	30	150
Pregnant	1200	1200	320	30	18	1.7	175	40	150
Lactating	1200	1200	355	25	15	1.8	175	45	150

Table 4 Availability of dietary energy from various food groups and nutritive value of the diet in Saudi Arabia

Food groups	Available calories/head/day	
	1993-95*	Desirable level**
Total Cereals	1579	924
Pulses and Beans	30	139
Roots and Tubers	34	116
Vegetables and Fruits	356	116
Total Animal Products	334	462
Added Fats and Oils	397	231
Nuts and Oilseeds	16	69
Sugar and Honey	358	185
Others (Beverages, spices etc)	24	68
Total Calories	3128	
Average Requirement	2310	
Calories % Requirement	135	
Dietary Score**	90	100

*Food Balance Sheets 1993-95. Ministry of Agriculture and Water. Kingdom of Saudi Arabia

** FAO [34]

Table 5 Desirable dietary pattern (Per caput requirement at national level) for Saudi Arabia.

Food groups	Physiological level	Retail level	Production level
	kg/Annum	kg/Annum	kg/Annum
Cereals	98	108	122
Pulses and Beans	13	14	16
Roots and Tubers	19	21	24
Vegetables and Fruits	66	73	82
Total Animal Products	110	121	136
Added Fats and Oils	9	10	12
Nuts and Oilseeds	5	6	7
Sugar and Honey	15	17	19
Others (Beverages etc)	9	10	12
Total Food	344	380	430
Total Calories/head/day	2100	2310	2600

Table 6 Nutrient densities for nutrients to meet needs of all family members.

Nutrients	Density per 1000 kcal
Energy	See Table 1 and nutritional goals
Protein	20 – 25 g
Total fats	16 – 27 g
Saturated fats	< 11 g
Carbohydrates	140 –190 g
Fibre	8 – 20 g
Vitamin A (retinal)	350 – 500 R.E.
Vitamin C	25 – 30 mg
Thiamin	0.5 – 0.8 mg
Riboflavin	0.6 – 0.9 mg
Niacin	6 – 10 mg
Folates	150 –200 μg
Iron	11 mg (30-60 mg is needed during pregnancy)
Zinc	6 – 10 mg
Calcium	500 mg
Iodine	75 μg
Fluoride	0.5 – 1 mg
Sodium	< 2.5 g