

Chapter 3

Consumption, availability and food policies

Fruit and vegetable consumption

This section reviews quantitative information on consumption of fruit and vegetables from published and unpublished surveys. Most of the survey results were published in the international scientific literature, but some were retrieved from national journals with limited circulation and from government reports. Studies and reports presenting information on the frequency of consumption only were excluded. Another selection criterion was the level of representativity of the study sample, at the national or sub-national level, although in special cases, data on smaller, selected groups of populations were retained for the purpose of highlighting specific points. The review focuses on surveys conducted in the last couple of decades; earlier data are considered only if they are of special significance or if they document specific aspects, such as time trends.

In view of the paucity of information on food consumption in the developing regions of the world, recourse was made to the series of Nutrition Country Profiles (NCPs) of the Food and Agriculture Organization (FAO) to obtain a glimpse, albeit crude, of the situation in these countries. NCPs are prepared in a standard format and provide information on the food and nutritional situation in individual countries. Data are derived from the UN



agencies' global data banks, complemented by information from national institutions and independent experts from the countries. The quality of the information on food consumption is highly variable between countries, but is mostly rather crude. Only overall fruit and vegetable consumption data are reported, and little, if any, methodological information (sampling technique, survey methods, individual food items included under either category, general context of the survey) is provided. Some surveys used the household budget survey method, others used food frequency questionnaires, yet

others used weighed or estimated food intake records over a variable number of days (for more information, see http://www.fao.org/es/esn/nutrition/profiles_en.stm). Finally, the FAO food balance sheets (see Chapter 2) were used to obtain an overview of the situation worldwide, as well as to detect trends over time (FAOSTAT, 2000).

From the above, it is apparent that the data reported in this chapter have been generated by a variety of methods, some of which are known to provide only a crude estimate of dietary intake. A detailed description of the diverse approaches is provided in Chapter 2. The limitations encountered in trying to provide a general picture of the consumption of fruit and vegetables are detailed below, and should be kept in mind when considering the data and drawing conclusions.

Categories of fruit and of vegetables

The presentation of data-sets on consumption of fruit and vegetables as aggregated groups is an important issue that can seriously limit their comparison and interpretation. In some cases, only values for combined fruit and vegetables are provided. More frequently, separate values are given for the two categories, but these are not homogeneous across studies, as they may or may not include individual items such as potatoes, starchy fruit (e.g., bananas), dry and/or fresh pulses, or fruit and vegetable juices. Unfortunately, it has not been possible

to fully harmonize the data and the errors introduced when comparing two non-identical food aggregations can be neither corrected nor controlled for. Indeed, the most serious and widespread limitation is that reports only seldom specify the individual fruit and vegetable items included in or excluded from their analyses. Examples of detailed descriptions of the food items included within the fruit and vegetable categories are the CSFII surveys (USDA Food Surveys Research Group, 2003a) and the multicentre European Prospective Investigation into Cancer and Nutrition (EPIC) (Agudo *et al.*, 2002). The lack of detail in the reports from developing countries may be accounted for by the fact that the focus of these surveys has been food security and therefore the emphasis was placed on staple foods rather than the low-energy content fruits and vegetables. However, a similar paucity of data on food groupings is shared by several reports from developed countries.

The problem is compounded by the loose and sometimes imprecise use of botanical classification of fruit and vegetables. Thus, "roots and tubers" may or may not be included in the vegetable category; potatoes are sometimes, but not always, included in "roots and tubers"; olives may be specified as fruits; starchy fruits and vegetables (bananas, yams, breadfruit) may or may not be listed in their respective categories; the category of pulses is sometimes given separately but it is almost never specified whether fresh pods are included or not in the vegetable category. The term "legumes" is used in a loose manner, especially in the non-English literature, where it sometimes refers to fresh vegetables in general. Fruit and vegetable juices and nectars may or may not be listed separately, as may canned and preserved fruits. This may introduce a large margin of uncertainty

around the reported values. A further problem is the fact that certain items are country-specific. Thus, inclusion or exclusion of a food item here was determined with the purpose of maximizing the comparability of the data-sets. As a rule, potatoes, pulses and canned beans were excluded from the vegetable category, while "beans", "peas", "fresh legumes" and "canned vegetables" were included. "Other root vegetables" were also included. Olives were excluded. For the category of fruit, the following items were excluded: jams, preserves, dates, bananas, plantains, nuts and dry fruits. The fruit category includes fruit juices, fruit nectars and canned fruits. An exception was made with the food balance sheet data, where bananas were included in the fruit category, in view of the important position of bananas in the diet of large regions in Africa and Latin America. This inclusion is not based on evidence of any potential health-protective effect.

In conclusion, an attempt was made to harmonize the categories of fruit and vegetables across the various surveys. However, this process has been possible only to a limited extent and no presumption can be made about the homogeneity of the categories in the various studies.

Age and sex groupings

Another factor that limits the comparability of food intake data from the various sources derives from the disparity in the sex and age composition of the study samples. Often data are given as averages for both sexes combined. In some cases, age groups do not overlap, in other cases the range is wide and no information on the median or mean age of the entire group is provided. While age has a bearing on the total volume of food consumed as well as on total energy intake (increasing with age from childhood to maturity and levelling off later to fall in

advanced old age), it cannot be assumed that the same pattern applies to the intake of fruit and vegetables. Indeed, an age-associated increase in fruit and vegetable consumption can be seen in some but not all data-sets. More important might be the possible change in the spectrum of individual food items consumed at various ages. A clear case is that of consumption of fruit juices and nectars that increases sharply in the second to third years of life, remains high during childhood, and then declines with advancing age.

National surveys

Nationally representative data on fruit and vegetable consumption were available for 21 countries including China, India, Israel and the Philippines. The remaining 17 countries include 14 within the WHO European Region and Australia, Japan and the USA.

Figure 1 shows the data obtained in Australia (McLennan & Podger, 1999), the Baltic republics (Pomerleau *et al.*, 2001), Belgium (Kornitzer & Bara, 1989), China (Institute of Nutrition and Food Hygiene, 2002), Denmark (National Food Agency of Denmark, 1990), Finland (National Public Health Institute of Finland, 1998), France (Volatier & Verger, 1999), India (Department of Women & Child Development, 1998), Ireland (Irish Nutrition & Dietetic Institute, 1990), Israel (D.N. Kaluski, personal communication), Italy (Turrini *et al.*, 2001), Japan (Office for Life-style Related Disease Control, 2002), the Netherlands (Netherlands Nutrition Centre, 1998), Norway (Johansson & Sovoll, 1999), the Philippines (Food and Nutrition Research Institute, 2001), Spain (Instituto Nacional de Estadística, 1991), Sweden (Becker, 2001), the United Kingdom (Gregory *et al.*, 1990) and the USA (USDA Food Surveys Research Group, 2003b).

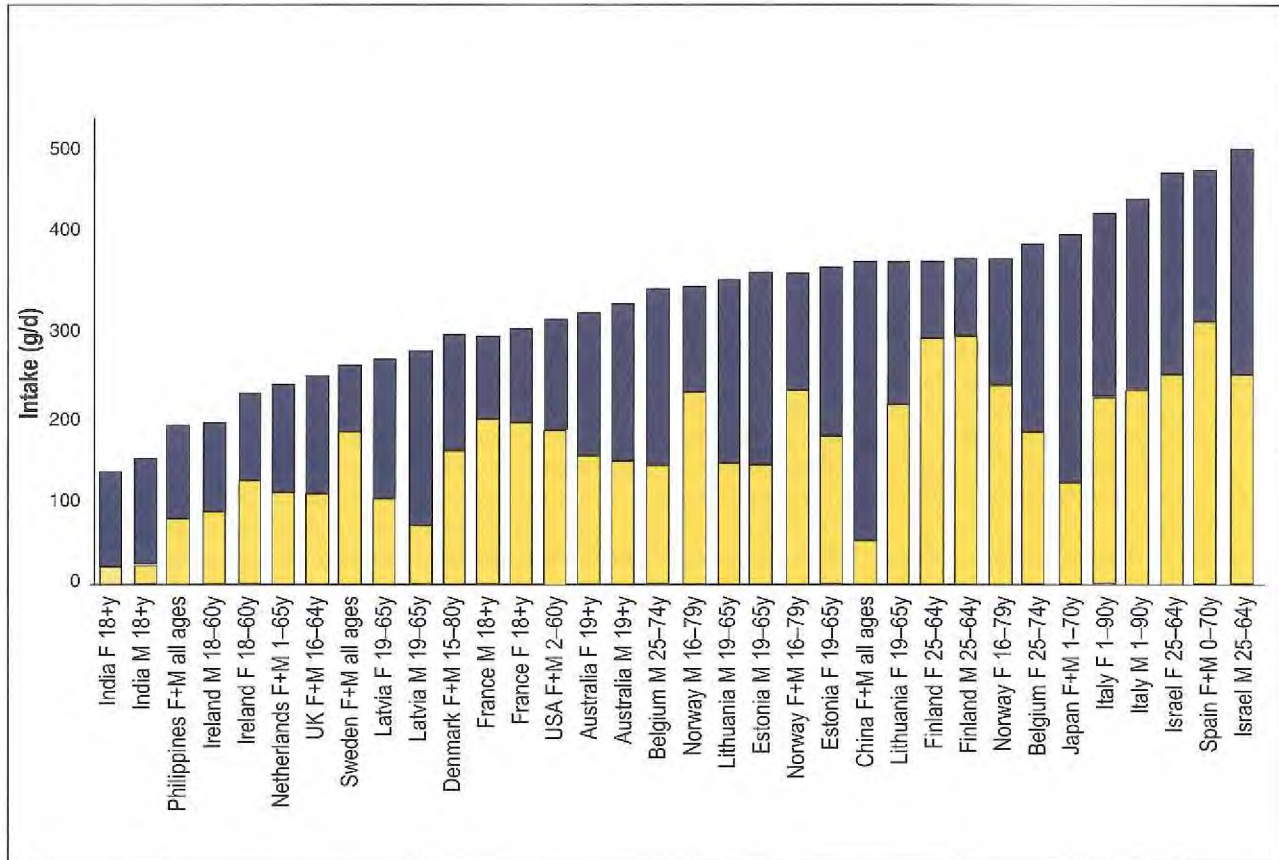


Figure 1 Overview of the fruit (yellow) and vegetable (blue) consumption in 21 selected countries, as reported by the most recently conducted national surveys

There are obvious limitations to this comparison, such as the different age ranges used, the survey methods, the dates of the survey and the items included in the categories of fruit and vegetables. Where the data permitted, values shown in Figure 1 are for adults, but in some cases the range includes children and/or the elderly. About half of the surveys give data for men and women separately.

The picture that emerges shows a wide disparity in intake across countries, with a four-fold difference between the lowest intake of just over 100 g of fruit and vegetables per day in India and the highest intake of almost 500 g/d in Israel, a difference in intake

of well over 300 g/d. Developing countries have the lowest intake, for example 128–148 g/d in India and 183 g/d in the Philippines. In most European countries, consumption is between 250 and 350 g/d of total fruit and vegetables, but there is wide diversity between European regions. Japan has one of the highest levels of overall consumption (almost 400 g/d), while the USA and Australia have about 300 g/d. Fruit consumption in individual countries appears to fluctuate independently of vegetable consumption and may represent between less than a fifth of the total intake (India, China) up to more than half (Finland, Spain). There seems to be a slight tendency

for developed countries to have higher proportions of fruit consumption. In particular, Scandinavian countries (Norway, Sweden, Finland) have very high fruit intake.

Selected multi-centre studies

A multi-country survey on the prevalence of non-insulin-dependent diabetes mellitus and related risk factors was carried out in Algeria, Bulgaria, Egypt, Greece and Italy on small homogeneous groups of non-diabetic men and women aged 35–60 years (Karamanos *et al.*, 2002) (Figure 2). Food consumption was assessed by a validated dietary history method. The results indicate that consumption of

fruit and vegetables is similar in North African countries and in European Mediterranean countries, with intakes ranging from 416 g/d to 501 g/d of total fruit and vegetables. The data from Italy are in good agreement with the national results. Interestingly, the highest intake was recorded in Bulgaria (536–594 g/d). For all countries except Egypt, fruits represented half or more of the total amount.

The multi-country SENECA project (Survey in Europe on Nutrition and the Elderly, a Concerted Action) collected information on the diet of elderly people (born between 1913 and 1918) in 11 European countries in an initial survey in 1988–89 and in a follow-up in 1993 on a smaller sample. Dietary intake was assessed by a three-day food record in household measures, followed by an interview with a dietitian to establish the weight of portion sizes. The method was strictly standardized across all study sites, affording a set of uniquely comparable data. The data reviewed here are those for people aged 74–79 years in Belgium, Denmark, France, Greece, Italy, the

Netherlands, Poland, Portugal, Spain, Switzerland and the United Kingdom (Trichopoulou *et al.*, 1995b; Schroll *et al.*, 1996, 1997).

A surprisingly high consumption of vegetables was recorded everywhere, but potatoes and other roots were included in the vegetable category, thus inflating the total amount to a degree that differs depending on the study site. The proportion covered by potatoes appears to range roughly from over two thirds in Denmark and Poland to less than one third in Italy and one French site (Schroll *et al.*, 1996). Therefore, these data should be considered only within the context of the SENECA project. For women and men, the highest overall consumption of fruit and vegetables was recorded in Spain (766 g/d for women, 935 g/d for men), followed by Portugal and France, Belgium, the Netherlands, Greece and Italy. The lowest intakes were recorded in Denmark (347 g/d for women and 371 g/d for men) and Switzerland (about 420 g/d for both men and women). Fruit consumption was also highest in Spain (about 550

g/d) and lowest in Denmark (120 g/d), and followed a pattern of increasing consumption from northern to southern Europe. In most sites, fruits represented well under half of the overall amount of fruit and vegetables consumed, but reached about 50% in Greece and Portugal and over 60% in Italy and Spain (Schroll *et al.*, 1997). For Denmark, the Netherlands, Spain and Switzerland, data are available on the same subjects assessed four years earlier (Schroll *et al.*, 1997). The changes over the intervening four years were negligible and within the methodological error.

The dietary pattern of 519 878 healthy adult men and women was assessed by food frequency questionnaire in 27 cohorts recruited in ten European countries within the framework of the EPIC project. Details on the background, rationale and design of the study, on population characteristics, the selection process, data collection and some preliminary results are given elsewhere (Riboli, 1992; Slimani *et al.*, 2000, 2002; Riboli *et al.*, 2002), along with detailed information on the food items included in the categories of fruit and vegetables. The diet of a sub-sample of 35 955 men and women aged 35–74 years (mean age, 55 years for women, 57 years for men) randomly selected from each EPIC cohort was assessed by a standardized 24-hour recall method (Agudo *et al.*, 2002). The cohorts are located in Denmark (two sites), France (four sites), Germany (two sites), Greece (one site), Italy (five sites), the Netherlands (two sites), Norway (two sites), Spain (five sites), Sweden (two sites) and the United Kingdom (two populations). Men and women participate in the study in 19 centres, and only women in eight. The data presented are adjusted for age, season and day of the week, thus providing an internally comparable set of data (Figure 3), although these data differ

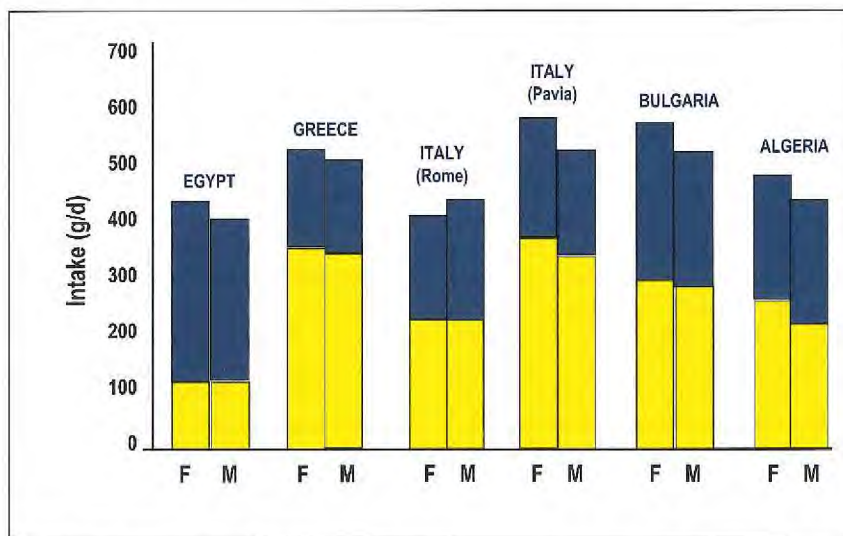


Figure 2 Fruit (yellow) and vegetable (blue) consumption in the Mediterranean countries participating in the Mediterranean Group for the Study of Diabetes (MCS D)

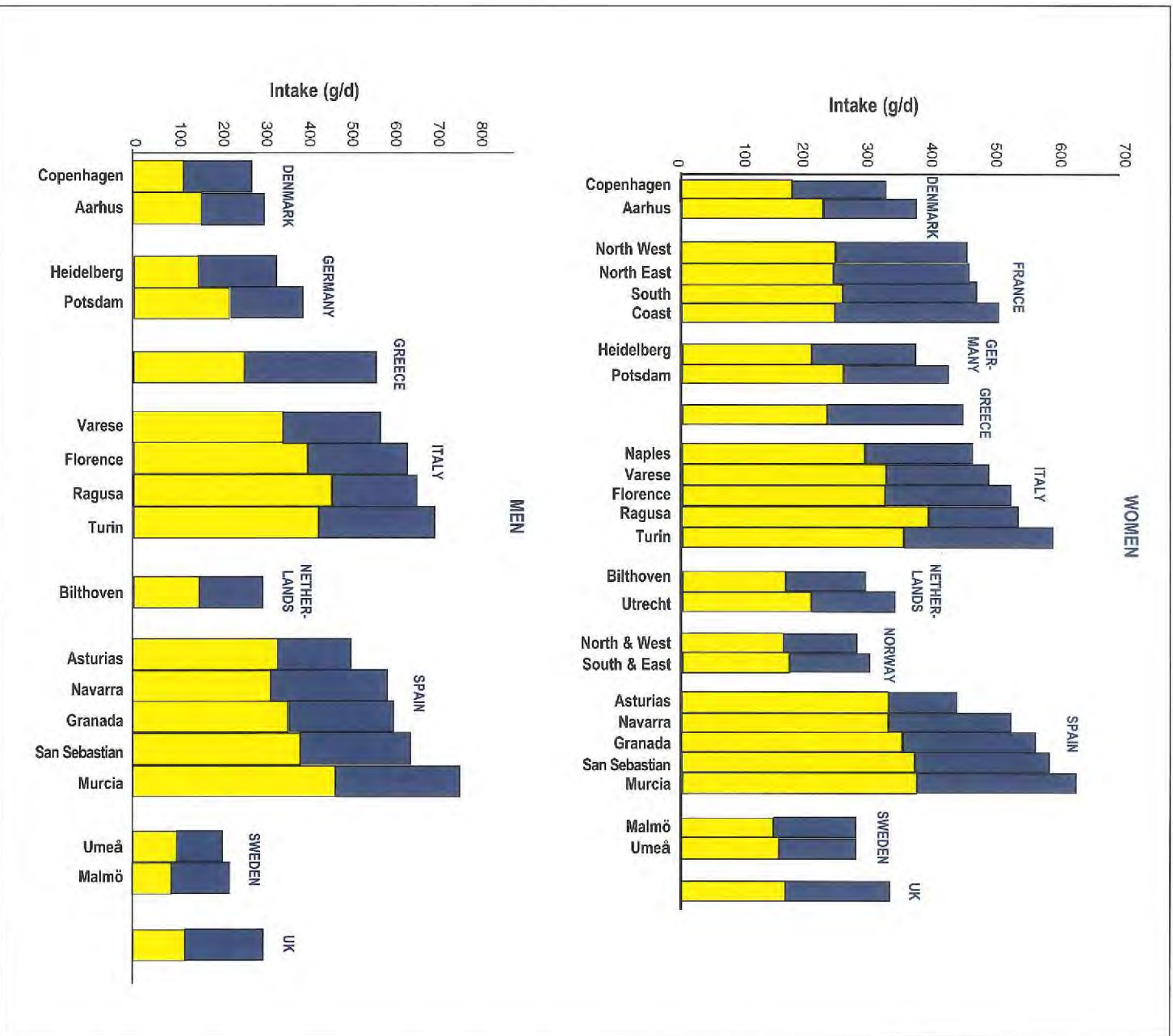


Figure 3 Fruit (yellow) and vegetable (blue) consumption in the 27 EPIC cohorts from 10 European countries

only very slightly from the unadjusted values. For both sexes, the highest overall consumption of fruit and vegetables was seen in Spain (721 g/d for men in Murcia) and Italy, while the lowest consumption was found in Sweden (225 g/d for men in Umeå), followed by the Netherlands, Norway, the United Kingdom and Denmark. Where the information is available, women seem to consume similar amounts of fruit and vegetables to men, except in Greece, Italy and Spain, where men have appreciably higher consumption.

Besides the notable variations in total intake between countries, there are also wide variations within countries, particularly in those countries where consumption is highest (Italy, Spain). The intake of fruit generally represents about half the total intake, but rises to two thirds in countries where the total intake is high. Thus, the lowest consumption of fruit was recorded in Sweden (122–159 g/d) and the highest in Spain (454 g/d) and Italy (448 g/d). The data from this study indicate that the countries with the highest total intake have the largest within-country variation and the highest consumption of fruit. Similar high variability is shared by other studies, and is reflected in the large difference between the intake of individual consumers and the mean intake of the entire group.

The European DAFNE project, designed to harmonize the data of the household budget surveys of diverse countries, produced comparable data for ten European countries: Belgium, Germany, Greece, Hungary, Ireland, Luxembourg, Norway, Poland, Spain and the United Kingdom. All surveys were conducted between 1987 and 1995 (Naska *et al.*, 2000). Despite limitations inherent to the nature of the data (level of aggregation of the data, household level of the information, foods being reported as crude values

rather than as edible portion, possible stores present in the household, data representing availability rather consumption), the harmonized household budget surveys permit cross-country comparisons. Fruit and vegetable availability ranged from 217 g/d in Ireland, almost equally divided between the two categories, to the values recorded in Spain (463 g/d) and in Greece (613 g/d), which include higher proportions of fruit. As data for eastern Europe are scarce, it is interesting to note the values recorded in Poland (302 g/d in 1988) and Hungary (354 g/d in 1991), the difference being mainly a result of higher availability of fruit in Hungary than in Poland. The highest availability of fruit is again recorded in Greece (346 g/d) and Spain (283 g/d). Data from Greece for 1988 and 1994 show an unexpected decline in availability of both fruit and vegetables, which dropped from 613 g/d in 1988 to 496 g/d in 1994. On the whole, the ranking of the DAFNE data on the basis of fruit and vegetable availability is in good agreement with the results of national surveys (Figure 1) and the EPIC (Figure 3) and SENECA studies on food consumption, with Ireland and the United Kingdom at the lower end and Greece and Spain at the higher end.

Developing countries

For a small number of developing countries, information on fruit and vegetable consumption was retrieved from the Nutrition Country Profiles series (FAO NCPs). Data for Iran, Mali, Morocco, Pakistan, Sri Lanka, Turkey, Venezuela and Viet Nam are shown in Figure 4. The data available do not separate fruit and vegetable consumption. While the quality of the data may be questionable, the picture that emerges is one of great disparity between countries. Asian countries (Pakistan, Sri Lanka, Viet Nam), Mali and Venezuela are at the lower end of

the spectrum, with intakes below 200 g/d. At the higher end of the spectrum, the Middle Eastern and North African countries (Morocco, Turkey and Iran) have intakes of over 350 g/d.

Availability and time trends in large regions

The food balance sheets of the FAO (FAOSTAT, 2000), collected with a unified and unchanging technique since 1961, offer a unique opportunity to examine time trends worldwide. The data are more correctly referred to as disappearance or availability figures, and thus are not directly comparable with the data obtained from dietary surveys. An additional difference is that bananas are included in the fruit category.

Figures 5 and 6 provide an overview of the availability of fruit and vegetables in major regions of the world and of changes over the last 40 years. A six-fold difference in fruit and vegetable availability is apparent across the world (Figure 5). The four regions in sub-Saharan Africa have the lowest levels overall, with countries in eastern Africa having less than 100 g/d. Western Europe, the Asian Near East and North America at the upper end have over 600 g/d.

In most developing regions, the availability of vegetables is higher than that of fruit, except in those regions where bananas represent a large percentage of the fruit (central Africa, Latin America and the Caribbean). In contrast, in the developed regions where the total availability of fruit and vegetables is highest (western Europe and North America), there is similar availability of fruit and of vegetables. Eastern European countries have very low intake of fruit compared with that of vegetables and compared with western Europe.

Different trends over time are observed between regions. In eastern and central Africa, availability of both

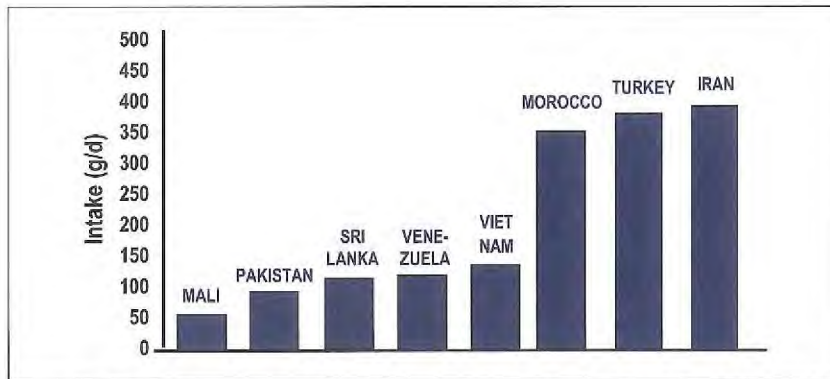


Figure 4 Total fruit and vegetable intake in selected developing countries for which recent, nationally representative data were available

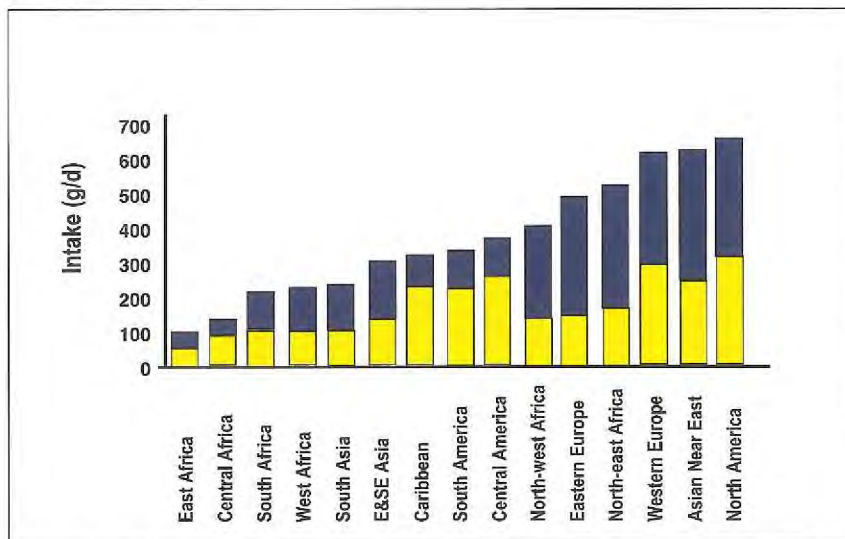


Figure 5 Fruit (yellow) and vegetable (blue) availability in large regions around the world. Data retrieved from the FAO Food Balance Sheets (FAOSTAT, 2000). To smooth out yearly fluctuations, five-year averages for 1996–2000 are shown.

fruit and vegetables decreased steeply, particularly in the last 20 years (Figure 6A). Total values for Latin America and the Caribbean and values for vegetables in southern Africa and for fruit in western Africa did not change over the period examined (Figures 6A and D). In contrast, a large number of regions show steady increases in both fruit and vegetable availability, the greatest increase occurring during the 1970s and early 1980s. These regions include devel-

oped countries such as those of North America and Europe (Figure 6C), but also countries 'in transition' such as northern Africa and the Near East (Figure 6B). A decrease in fruit and vegetable availability is seen in Japan, while most other countries in south-east Asia show a small increase over time (Figure 6E).

Variations within countries

Inspection of the standard deviations and quantile distributions of fruit and

vegetable intakes reveals great interindividual variation in patterns of consumption. Figure 7 displays within-country variations of fruit and vegetable intake in selected developed countries. The largest interregional difference is seen in the USA (USDA Food Surveys Research Group, 2003c), where it reaches 112 g/d, followed by Finland (87 g/d in men). Elsewhere, the differences are smaller, ranging between 36 g/d in Norway and 67 g/d in Finland for women. In those countries for which data are available, there appear to be larger differences between men than between women. In the United Kingdom, a four-fold difference was found between the 1st and the 4th quartiles in the amount of fruit and vegetables consumed by adults: 105 and 448 g/d respectively (Billson *et al.*, 1999). In the data from the EPIC project (Agudo *et al.*, 2002), the range observed within one country varies from non-existent or minimal (Sweden or Norway) up to 200 g/d as seen across the five sites in Spain (Figure 3). The SENECA study confirms the persistence of within-country variation in the elderly (data not shown).

Within-country diversity in intake also exists in developing countries, although the available evidence is scanty. Data from Iran show a difference of about 400 g/d between the lowest and highest intakes (222 g/d in Baluchistan and 647 g/d in Markaz, respectively; FAO NCPs). In Brazil, fruit and vegetable consumption varies from 236 g/d in Curitiba to almost 700 g/d in Rio de Janeiro (FAO NCPs). In India, amazingly large variations have been described, cutting across all strata of society and possibly reflecting diversity in production and access (Department of Women & Child Development, 1998). Figure 8 shows regional differences in fruit and vegetable consumption in India for different levels of education attained. Intakes range from less than 70 g/d to

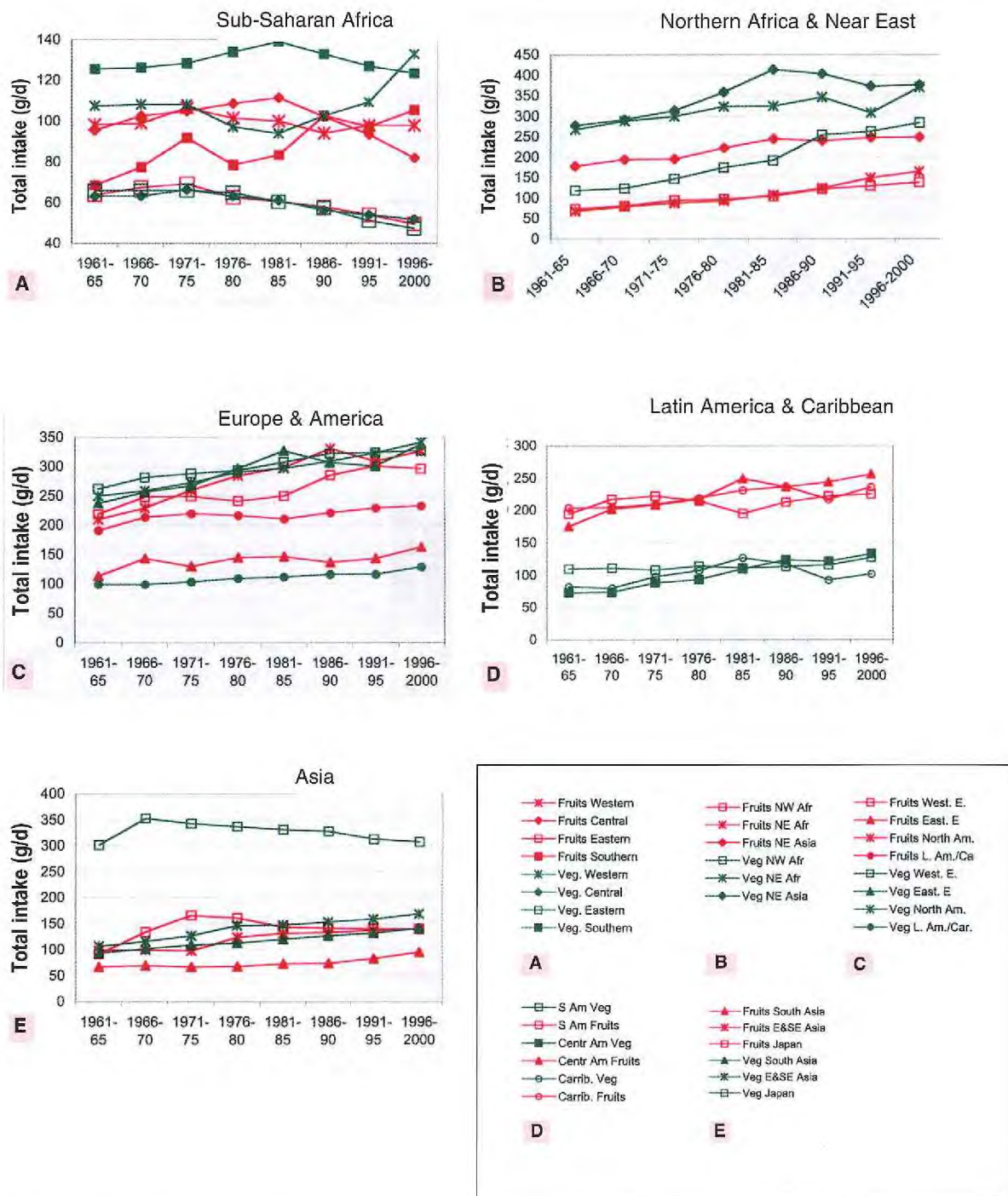


Figure 6 Time trends in fruit and vegetable consumption in large regions worldwide: Data retrieved from the FAO Food Balance Sheets (FAOSTAT, 2000). Except where mentioned, the same regions as for Figure 5 were selected.

over 200 g/d among illiterates and from 75 g/d to over 300 g/d among the college-educated. A 3–4-fold inter-regional difference is observed at all levels of education attained, from illiteracy through primary, secondary and high school to college education (see also below).

A large number of factors may account for the diverse food patterns observed within a country. For some countries, separate data are available for urban and rural populations. Almost everywhere, urban populations tend to consume more fruit and vegetables than rural ones, but the difference is often negligible (FAO NCPs). A national survey conducted in Turkey in 1984 indicated an average consumption of 408 g/d of fruit and vegetables, with an urban/rural difference of 425 g/d versus 392 g/d (FAO NCPs). The

survey also revealed a seasonal trend, with values of 518 g/d in summer and 482 g/d in winter. In Iran, the urban/rural difference was very marked, 523 g/d versus 389 g/d (FAO NCPs). Data from India (Department of Women & Child Development, 1998) and Pakistan (FAO NCPs) indicate very small, non-significant urban/rural differences. In China, a difference of 65 g/d was reported, from 345 g/d in the rural population to 410 g/d in the cities, the difference being related predominantly to fruit consumption (FAO NCPs; Institute of Nutrition and Food Hygiene, 2002). In Chile, in contrast, a nationwide survey in 1969 recorded intakes of relatively high amounts of fruit and vegetables (about 435 g/d), while later surveys conducted mostly in the Santiago area found lower intakes (around 300 g/d)

(FAO NCPs). Similarly in Ireland, intakes were slightly higher (30 g/d) in the rural population, among both men and women (Irish Nutrition & Dietetic Institute, 1990).

Another very likely determinant of fruit and vegetable intake is income. In the USA, intake is positively income-associated in both sexes and at all ages (USDA Food Surveys Research Group, 2003d) (Figure 9). The greatest effect appears to be in adolescent women, with a difference of about 100 g/d between the strata of highest and lowest income; for the other age groups the difference between the poorest and the richest amounts to 35–60 g/d. National data from the 1992 survey in China also indicate an appreciable positive income-associated gradient in total intake of fruit and vegetables, the higher-income group

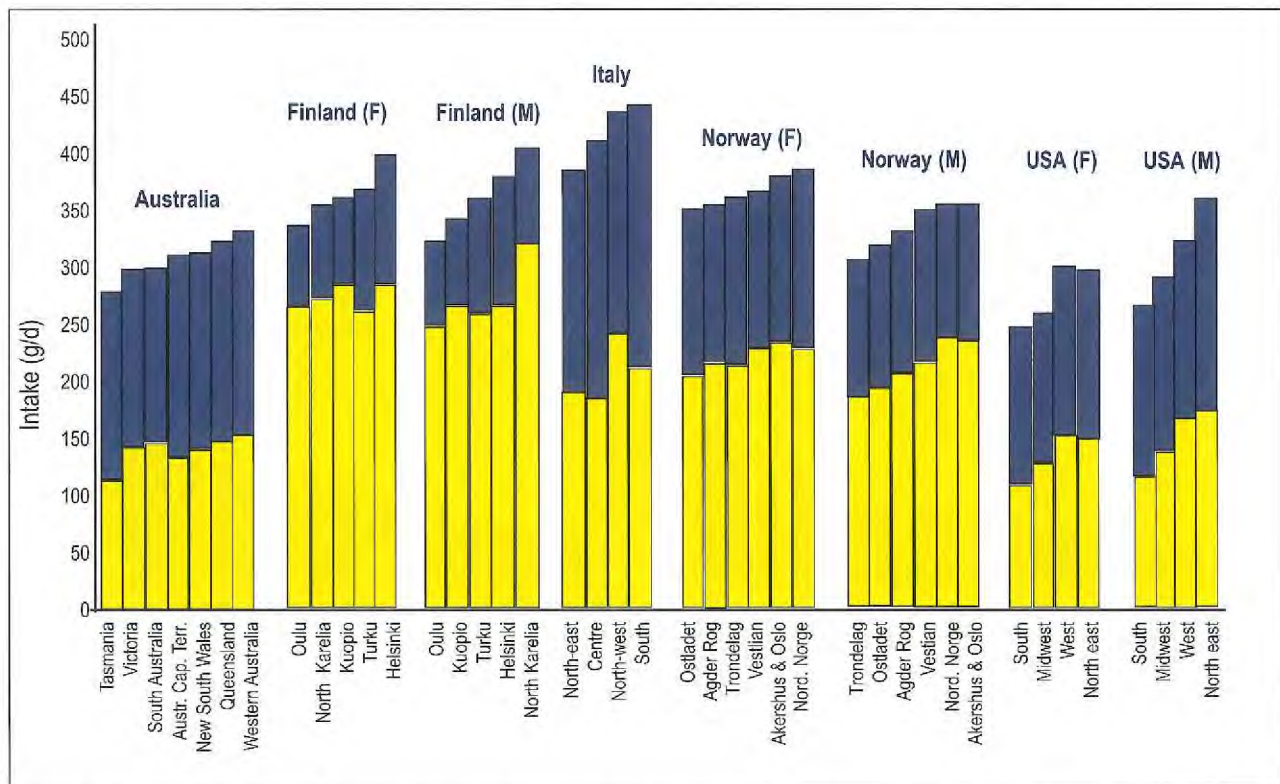


Figure 7 Regional differences in fruit (yellow) and vegetable (blue) consumption within selected developed countries

consuming three times more fruit than the lower-income group, while the difference in vegetable consumption was minimal (Institute of Nutrition and Food Hygiene, 2002).

Educational level, taken as a proxy for socioeconomic status, has been shown in several surveys to influence fruit and vegetable intake. The national data from India (Department of Women & Child Development, 1998) indicate that only part of the variation in fruit and vegetable consumption across the country can be accounted for by educational level (Figure 10); the differences in intake between regions are greater than those associated with the education attained within any given state, which reach a maximum of 183 g/d (2.5-fold) in Daman & Diu. The clear positive association with educational level found in several states (7/17) appears to be independent of the absolute intake, as it occurs in regions of both low and high total intake. In other regions, education was not associated with fruit and vegetable consumption. In yet other regions, fruit and vegetable intake steeply increases only at college educational level (Meghalaya, Chandigarh, Dadra & Nagar Haveli, Daman & Diu). Thus, the

amount of fruit and vegetables consumed by the college-level households in certain states may be lower than that of illiterate households in other states.

A positive association between educational level and consumption of fruit and vegetables has also been found in developed countries, such as the USA (Devine *et al.*, 1999; Xie *et al.*, 2003) and Australia (Turrell *et al.*, 2002). In Europe, the situation seems to be less clear, as the DAFNE data do not confirm a positive trend in the total amount consumed with increasing level of education. For the total consumption of fruit and vegetables, the trend, albeit slight, is for consumption to be higher at the lower levels of education (elementary level or less), a decrease of consumption in the secondary level of education, and an increase again at the university education level. However, looking at consumption of fruit and vegetables separately reveals an inexplicable decrease of fruit consumption with increasing education in Spain, but an increase in Greece. The other three countries for which values are available, Poland, Hungary and Belgium, present a U-shaped trend. Vegetable consumption decreases with education in

Greece, Hungary and Poland, while the relationship with education is less clear in Belgium and Spain.

These data are generally not adjusted for possible confounders, so that the relationship between intake and various parameters may be confounded by lifestyle covariant parameters such as smoking, alcohol-drinking habits or culture as well as by the ecological niche. Care must therefore be exercised in interpreting these associations. For example, stratification by ethnic group (Mexican American, other Hispanic origin, non-Hispanic blacks and non-Hispanic whites) in the USA has revealed differences in the pattern of fruit and vegetable consumption (USDA Food Surveys Research Group, 2003e). Although the differences are neither systematic nor very large, it appears that non-Hispanic blacks, who are likely to have lower educational attainment and lower income, tend also to be lower consumers. In Ireland, the unemployed and the unskilled have systematically lower consumption than "professionals" and "non manuals" (Irish Nutrition & Dietetic Institute, 1990).

Such diverse behaviour and the variety of forces responsible for it have

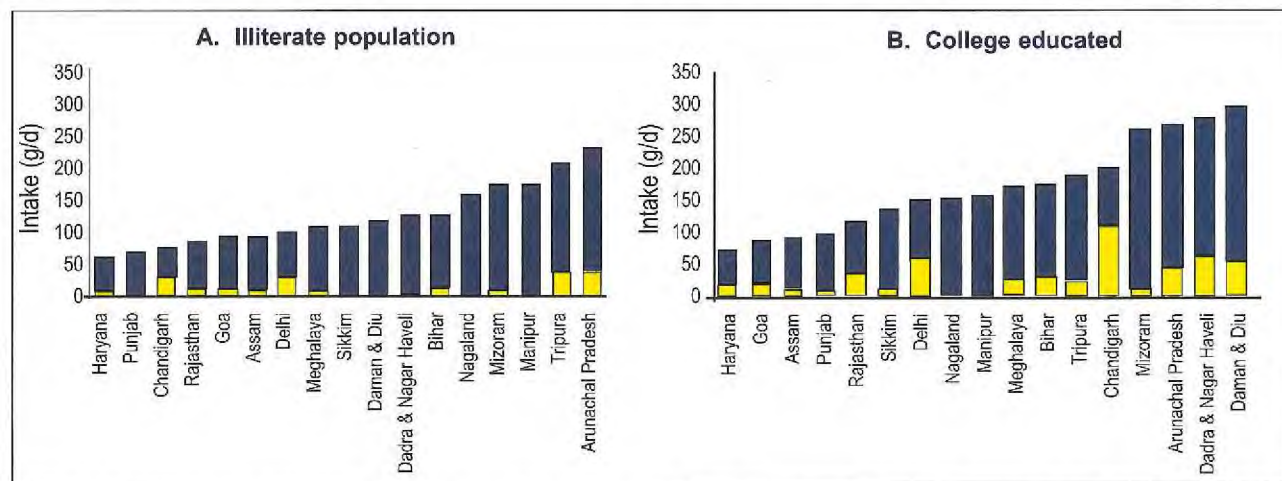


Figure 8 Geographical differences in fruit (yellow) and vegetable (blue) consumption in India, according to the education level attained

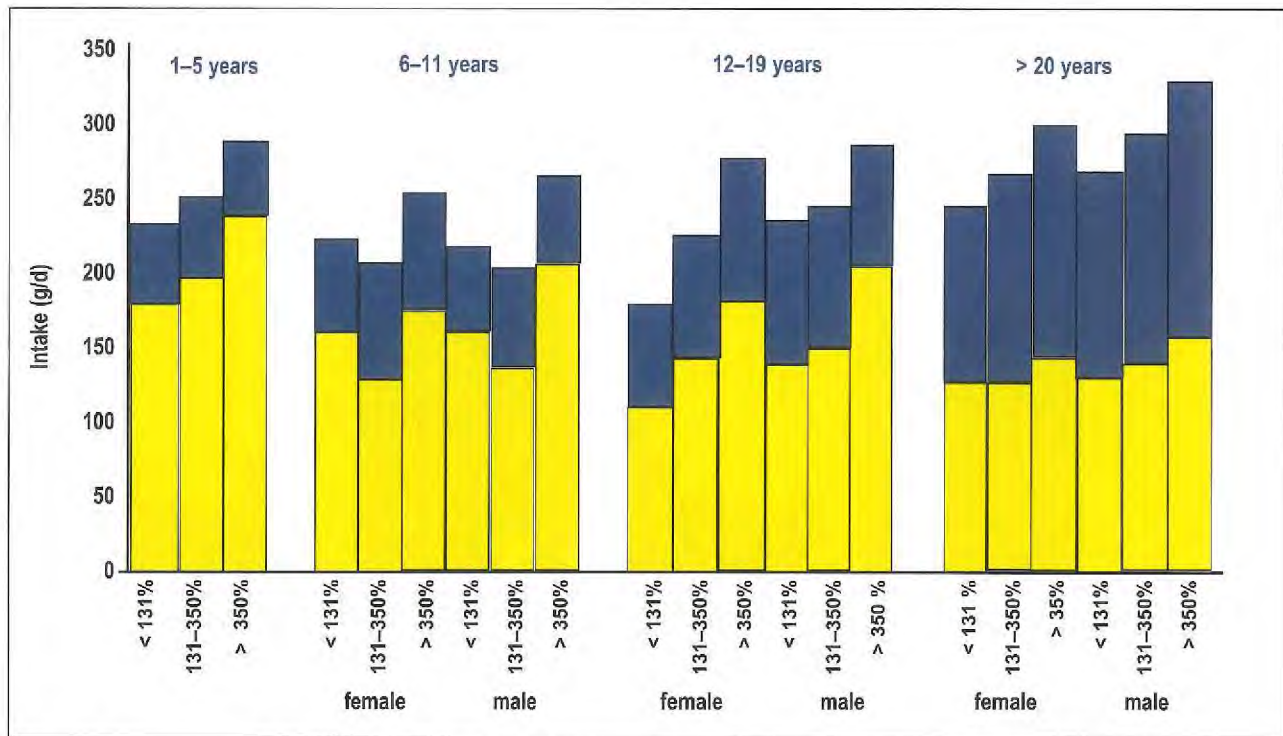


Figure 9 Differences in fruit (yellow) and vegetable (blue) consumption by household income and age class in the USA

started to be investigated, and are revealing that consumers' choices are shaped by an amazingly wide and complex array of factors, that include market forces, physical access, price, traditions, availability and many others.

Nutrition and food policies and special campaigns

Historical perspective

Nutritional research, programmes and food policy have shifted focus over the last hundred years. In the early 1900s, the focus was on identifying and preventing nutrient deficiency diseases, while in the 1940s and 1950s, attention moved to the identification of nutrient requirements. Subsequently, investigations were directed to the role of diet in maintaining health and reducing the risk of cancer, heart disease,

osteoporosis and other noncommunicable diseases. During the 1970s and 1980s, dietary fat was a major focus of research and policy, and later in this period the roles of dietary fibre and antioxidants were addressed. More recent epidemiological, clinical and laboratory research has been focused on foods and food groups, particularly fruit and vegetables. During the past 25 years, research findings suggesting an inverse association between fruit and vegetables and cancer have contributed to the development of international and national policy statements about cancer and the consumption of fruit and vegetables.

Doll and Peto (1981) estimated that approximately 35% of cancer deaths were related to diet (from 10 to 70%, depending on the type of cancer). Since then, a growing body of evidence has suggested that higher lev-

els of fruit and vegetable consumption are associated with reduced risk of some cancers (see Chapter 4).

Several comprehensive reviews of data regarding diet in relation to cancer, chronic disease and health concerns in general have identified foods, nutrients and other dietary components as being potentially important for cancer prevention (Assembly of Life Sciences, 1982; National Cancer Institute, 1986; James, 1988; US Public Health Service and Office of the Surgeon General, 1988; WHO, 1990, 2003). These also provided estimates of the potential effects of cancer-prevention efforts and recommendations and priorities for dietary change, including reducing the intake of total fats, especially saturated fat, maintaining desirable weight and improving diet quality. The earlier dietary guidelines included

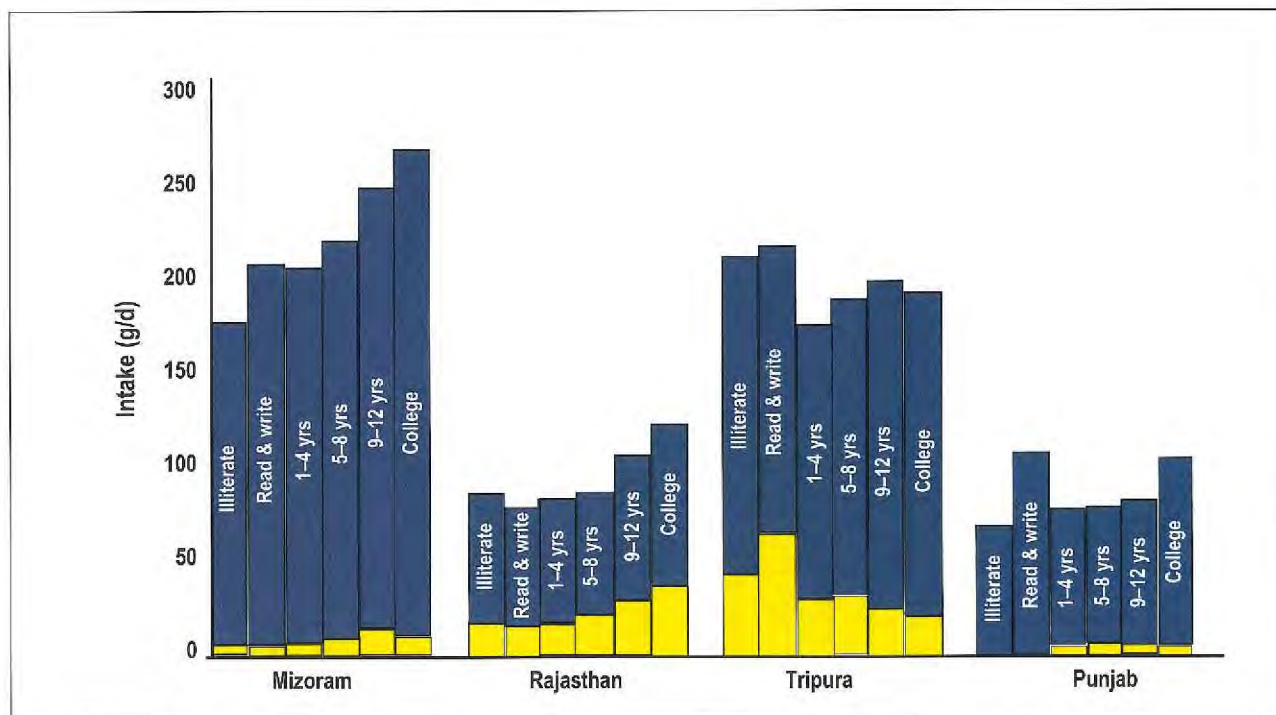


Figure 10 Fruit (yellow) and vegetable (blue) consumption by educational level in four representative States in India

few specific recommendations for fruits and vegetables. In the USA, the National Research Council (1989) provided a quantitative recommendation to "every day eat five or more servings of a combination of vegetables and fruit, especially green and yellow vegetables and citrus fruits". The recommended number of servings of fruit and vegetables was derived by calculating nutritionally balanced diets that would meet the overall dietary recommendations (Cronin *et al.*, 1987). These reports taken together provided a focus on dietary patterns containing a variety of foods, rich in plant foods including fruits, vegetables, cereals and whole grains, while being generally low in energy, fat, especially saturated fat, cholesterol and sodium.

Current policy and dietary guidelines

Over the years, nutrition and dietary guidelines have moved from focusing

solely on nutrient intakes and nutrient adequacy to recommendations that are more food-based and aimed towards health maintenance and food safety. In 2002, the WHO issued guidelines and policies for national cancer control programmes (WHO, 2002). These emphasized improved diet and increased fruit and vegetable intake as essential parts of the approach to cancer prevention. A joint WHO/FAO Technical Report (WHO, 2003) made it clear that a growing epidemic of chronic diseases, including obesity, diabetes mellitus, cardiovascular disease, hypertension and stroke, and some types of cancer, afflicting both developed and developing countries, is related to dietary and lifestyle changes, often linked to industrialization, urbanization, economic development and market globalization. While standards of living and food availability have improved, there have also been negative conse-

quences in terms of unfavourable dietary patterns and decreased physical activity. Fruit and vegetable intake still varies considerably between countries, in large part reflecting the prevailing economic, cultural and agricultural environments. The WHO/FAO report emphasized the need for concerted efforts to improve diet, with increasing intake of fruit and vegetables, and for a lifelong approach to healthy eating.

Recent reports from international and nongovernmental organizations have included recommendations for fruit and vegetable intake, as summarized in Table 9. The World Cancer Research Fund review (WCRF/AICR, 1997) estimated that "a simple change, such as eating the recommended five servings of fruit and vegetables each day, could by itself reduce cancer rates more than 20 percent". The first recommendation of the American Cancer Society's Guidelines

on Nutrition and Physical Activity for Cancer Prevention (Byers *et al.*, 2002) is to "eat a variety of healthful foods with an emphasis on plant sources" and specifically to "eat five or more servings of a variety of vegetables and fruits each day". The WHO/FAO Expert Consultation on Diet, Nutrition and the Prevention of Chronic Disease (WHO, 2003) recommends consuming at least 400 grams of fruit and vegetables per day.

Programmes to implement dietary guidelines and nutrition policy

National and regional health organizations translate these international policy statements into food-based dietary guidelines that reflect the cultural food patterns and the prevalence of noncommunicable diseases in individual populations (WHO, 1998). Such guidelines aim at disease prevention, taking into account local economic, food availability and food safety considerations (Becker, 1999; Löwik *et al.*, 1999; Valsta, 1999; US Department of Health and Human Services, 2000).

The WHO European Regional Office has provided Member States with a Regional Food and Nutrition Action Plan, which refers to fruit and vegetable consumption as a priority (WHO/EURO, 2000). WHO also provides information and assistance for developing food-based guidance systems (WHO, 1998).

The International Conference on Nutrition in 1992 called upon countries to develop national food and nutrition action plans (<http://www.fao.org/esn/nutrition/ICN/ICNCONTS.htm>). To date about 150 countries have such plans and another 20 have them under development. Many of these plans in developed countries, and to a lesser extent in developing countries, include goals for prevention of noncommunicable diseases through population-based dietary strategies.

The EURODIET project (1998–2000) established a broad network and a strategy and action plan for the development of European dietary guidelines and outlined ways for effective promotion of diet and healthy lifestyles in European Union member

states (Kafatos & Codrington, 2003). Other groups of countries also work together to develop nutrition plans, dietary guidelines and educational efforts. The examples in Figures 11–14 show how food-based dietary guidelines for different countries or regions translate the recommendations for fruit and vegetable intake and how they reflect cultural food patterns. Other pictorial representations of dietary guidelines have been reported (Painter *et al.*, 2002).

Recommended amounts of fruit and vegetables

Recommendations for fruit and vegetable intake are fairly similar across international and national guidelines, and are generally designated as servings of fruit and vegetables per day specified in household units, serving sizes or grams. Most publications specify consuming at least 400 grams or five or more servings daily of fruit and vegetables, with a range for the daily intake provided to allow for varying energy intakes. Several guidelines make separate

Table 9. International and national recommendations for fruit and vegetable intake

Agency (reference)	Recommendations	Fruit and vegetables	Suggestions for implementation
World Cancer Research Fund/ American Institute for Cancer Research (WCRF/AICR, 1997)	Promote year-round consumption of a variety of fruit and vegetables, providing 7% or more total energy	400–800 g/day or 5 servings/day or more. Not included: pluses/ fruit and vegetables (tubers, starchy roots and plantains)	
American Cancer Society (Byers <i>et al.</i> , 2002)	Eat a variety of healthful foods, with an emphasis on plant foods	5 servings/day or more	Include vegetables and fruits at every meal and for snacks. Eat a variety of vegetables and fruits. Limit french fries, snack chips and other fried vegetable products. Choose 100% juice if you drink fruit or vegetable juices
WHO (WHO, 2003)		400 g/day or more Not included: tubers	

recommendations for fruit and vegetables (Chinese Nutrition Society, 2000; see Figure 14).

Guidelines differ in what items are included in the food list for fruits and vegetables or in what are "counted" as a fruit or vegetable (see Chapter 1). There are also differences in what specific types of preparation or manufacture of fruits and vegetables are encouraged or emphasized. Potatoes may or may not be included in the food list for fruit and vegetables. For example, the World Cancer Research Fund report (WCRF/AICR, 1997) does not include potatoes (or other starchy roots or plantains) in its list of fruits and vegetables, nor do the food guides for several countries (Denmark, Germany, Ireland, the Netherlands) (Flynn & Kearney, 1999; Haraldsdottir, 1999; Hermann-Kunz & Thamm, 1999; Löwik *et al.*, 1999). Potatoes are included in the food lists for fruit and vegetables of Australia, the USA and the American Cancer Society (Miller *et al.*, 1997; US Department of Health and Human Services, 2000; Byers *et al.*, 2002).

Soy products are usually not included as fruit and vegetables, but other legumes may be included. Pickled vegetables and fruit-based-jams, jellies, preserves, candies and fruit-based soft drinks are frequently not included on the lists of fruits and vegetables. To ensure compatibility with guidelines that address fat intake, some fruit and vegetable dishes that are prepared with fat, salt or sugar may be excluded from the food list, or individuals may be cautioned to limit intake of these dishes. Most guidelines indicate that individuals should limit chips, snack chips and other fried vegetables. Many of the national guidelines also encourage consumption of specific fruits and vegetables, such as dark green leafy vegetables, red-orange fruit, citrus fruit and cruciferous vegetables.

Campaigns to increase fruit and vegetable intake

Over the past twenty years, a variety of campaigns have been conducted to inform individuals of the benefits of fruit and vegetable consumption. Health policy objectives and international and national dietary guidelines have served as the foundation for these campaigns (see above). The campaigns have included large national programmes, regional efforts and local programmes to develop and implement dietary guidelines in order to increase fruit and vegetable intake.

The campaigns have used information developed in earlier community intervention studies (Puska *et al.*, 1983; Farquhar *et al.*, 1990; Luepker *et al.*, 1994) and recommendations about implementing community-based

programmes (WHO, 1998). During the late 1980s, state projects were conducted in California, Australia, Canada, and some European countries to develop programmes and campaigns on fruit and vegetables; these provided valuable experience for further development and national expansion of fruit and vegetable campaigns (Foerster *et al.*, 1995; Miller *et al.*, 1996; Dixon *et al.*, 1998; Farrell *et al.*, 2000). Recent campaigns have expanded social marketing approaches and community-based implementation methods and draw on the scientific credibility of sponsorship by national, state and local health institutions. A major element is partnerships between health agencies, nongovernmental organizations for cancer or heart disease prevention and the fruit and vegetable industry and agricultural groups. The first national initiative was the US National Cancer Institute's 5-A-Day For Better Health Program, initiated in 1991 (see below). The methods in this programme and the experience gained have provided a model for many programmes to develop national partnerships for development and implementation of fruit and vegetable campaigns (National Institutes of Health and National Cancer Institute, 2001). A variety of campaigns conducted predominantly in Europe and North America have focused on the five-a-day theme for recommendation of fruit and vegetable intake. In these, programme partners work together to develop, implement and evaluate interventions. Such campaigns disseminate messages and conduct activities aimed at behavioural change in relation to fruit and vegetable intake, involving a variety of components: media and communications; point-of-sale interventions; community-level programmes, including public health agencies, school-based and worksite programmes; partnership activities with the food industry, retailers and

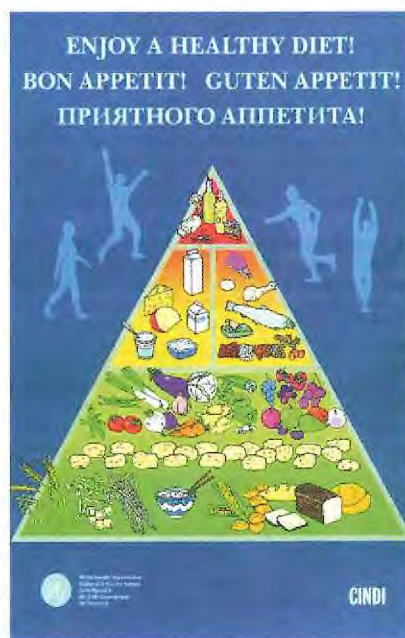


Figure 11 CINDI dietary guide from the WHO Regional Office for Europe (pyramid) (WHO/EURO, 2000). The recommendation is to eat a variety of vegetables and fruits, preferably fresh and local, several times per day (at least 400 g per day)



Figure 12 Canada's Food Guide to Health Eating (rainbow) (Health Canada, 2002) The advice is to eat 5–10 portions of fruit and vegetables per day

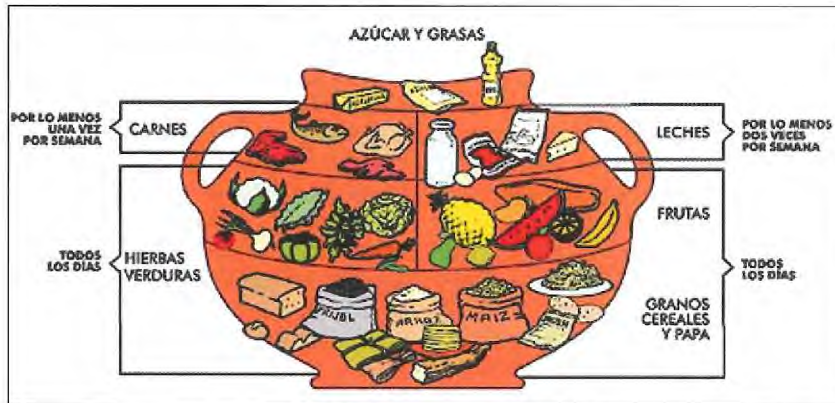


Figure 13 Guatemalan Dietary Guide (pot) (INCAP/OPS, 2000) The recommendation is to eat fruit and vegetables including leafy vegetables, every day

fruit and vegetable producers; and research efforts. Media components are implemented in complementary ways at the national or state level and at the local level. Examples of such campaigns are described below.

5 A Day Program—USA

The *Eat 5 A Day—for Better Health! Program* originated as a pilot programme in 1988 in the state of California through the California Department of Health. It was initiated nationally in the USA in 1991 by the National Cancer Institute (NCI) as the

public side and the Produce for Better Health Foundation (PBH) as the private side (Produce for Better Health Foundation and National Cancer Institute, 1999). PBH is a non-profit organization supported by approximately 1000 donors from the fruit and vegetable industry, supermarkets and other organizations and individuals interested in health promotion. The goal is to increase the average consumption of fruit and vegetables *per capita* to five or more servings every day by providing consumers with information about how to incorporate more servings of these foods into their daily eating patterns and by creating a healthy food environment wherever people eat, in schools, at workplaces or at home.

After a favourable national evaluation of the first decade of the programme in 2000, the National 5 A Day Partnership was formalized and expanded in April 2001. This partnership increased the number of both private and public stakeholders in the US programme. New partners formally added included the Centers for Disease Control and Prevention (CDC), the American Cancer Society (ACS) and several mission areas within the US Department of Agriculture (USDA). These new partners provided more federal and local support. CDC now funds several state 5 A Day research and demonstration projects. USDA has launched a pilot project in four states to bring fresh fruit and vegetables into school classrooms. Coordinators from each of the 50 states, plus all the US Territories and military branches, form the rest of the National 5 A Day Partnership, which is now the largest public–private partnership promoting health in the USA.

The partners are also targeting specific population sectors. NCI targets African American men with a message to *Eat 5 to 9 A Day*. PBH,

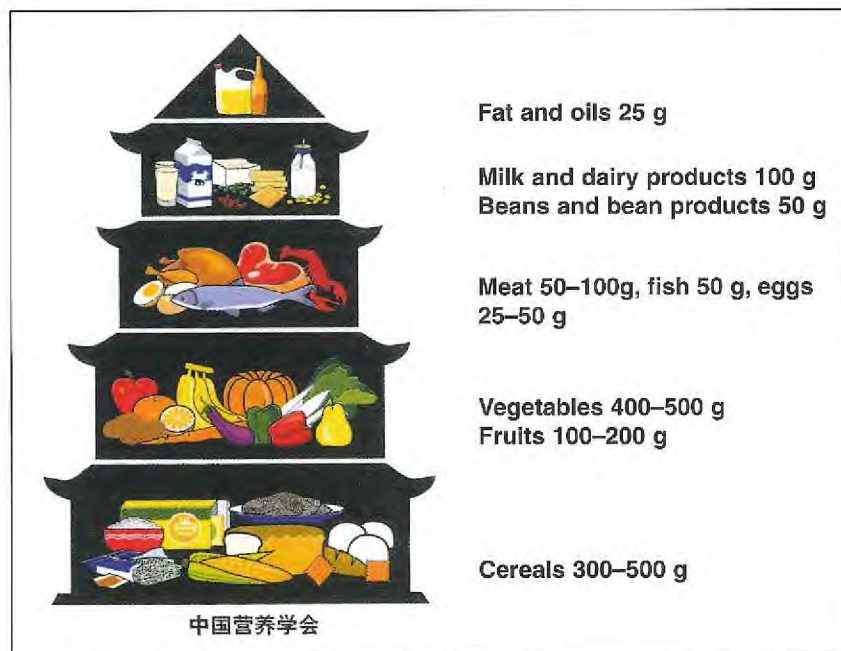


Figure 14 Dietary guidelines from the Chinese Nutrition Society (2000) (pagoda)
The recommendation is to eat 400–500 g of vegetables/day and 100–200 g of fruits

focusing on female shoppers, has launched a campaign called *5 A Day The Color Way*. The American Cancer Society's 5 A Day Body and Soul programme is targeting African American women through the black church networks. To reach Spanish-speaking consumers, both NCI and PBH materials have been adapted with appropriate ethnic food choices and visuals promoting *Coma 5 al día y Sea Activo* (Eat 5 A Day and be Active) and *5 A Day—Coma Sus Colores Cada Día!* (5 A Day—Eat Your Colors Every Day!). California 5 A Day has taken the lead in developing many of these materials in their Latino 5 A Day programme.

In all cases, the goal is to promote a positive message about diet and a healthy lifestyle. Eating low-fat meals that include five to nine servings of fruit and vegetables every day is a cornerstone of a healthy life plan. Care is taken not to disparage other food groups, and to promote a colourful

variety of vegetables and fruit in culturally appropriate ways and in the context of a low-fat diet; the use of whole grains and minimal use of salt and sugars are also strongly suggested.

NCI and PBH have established criteria to define promotable products that may be promoted as part of the 5 A Day Program. These criteria are intended to keep the 5 A Day Program consistent with US federal nutrition objectives, dietary guidelines and food labelling regulations (US Department of Health and Human Services, 1990, 2000). These criteria are now being re-evaluated to take into account the latest knowledge about fruits and vegetables and new fruit/vegetable products in the US food supply. At the national level, 5 A Day partners also include the United Fresh Fruit & Vegetable Association and the National Alliance for Nutrition and Physical Activity (NANA). The former is a trade organization representing the fresh fruit and vegetable industry, while

NANA is a coalition of over 200 organizations promoting public policy changes to improve both nutrition and physical fitness. NANA leaders include the Center for Science in the Public Interest, American Public Health Association, American Heart Association, American College of Preventive Medicine and many state departments of health. In addition to participating in the NANA coalition, United and PBH are pressing to expand the USDA free fresh fruit/vegetable pilot programme into other schools nationwide.

At the community level, coordinators in each state health department help to implement the 5 A Day programme by targeting their own audiences with their own materials or materials available through the national partners. State and local coalitions involve both the public and private sectors to implement activities at the local level. Local partners include industry as well as local ACS divisions, regional USDA offices, schools and others.

A great strength of the programme has been its focus on organizing and expanding the number and reach of the 5 A Day National Partnership, as much as promoting the actual 5 a day message. The programme has shown the feasibility of health agencies working in partnership with agricultural boards and commissions, fruit and vegetable companies and supermarkets to deliver wide-reaching mass-media messages with modest government resources (National Cancer Institute, 2002).

A survey of 2544 adults conducted in 1997 showed that general awareness of the recommended daily servings of fruits and vegetables had increased from 7.7% in 1991 to 19.2% and knowledge of the 5 A Day programme had increased from 2.0% to 17.8% (Stables *et al.*, 2002). Preliminary data showed a modest increase in the mean intake of total

fruit and vegetables (from 3.75 servings per day in 1991 to 3.98 in 1998) (National Institutes of Health and National Cancer Institute, 2001).

Australia

Several campaigns aimed at improving fruit and vegetable consumption have been conducted in Australia, initiated at the state level. The Western Australia Health Department directed a campaign with the slogan "Fruit 'n' Veg with Every Meal" (Health Department of Western Australia, 1990). Following an evaluation showing a limited impact of this slogan, the department moved in 1991 to using a quantitative message, "2 Fruit 'n' 5 Veg Every Day" (National Health and Medical Research Council, 1991). Surveys conducted in Western Australia identified barriers to increasing consumption of fruit and vegetables including habit, lack of knowledge about the amount of fruit and vegetables to eat for good health, concern about high prices and poor quality, particularly of fruit; and boredom with and lack of preparation ideas for vegetables. On the basis of the Western Australian experience, Victoria conducted a "2 Fruit 'n' 5 Veg Every Day" campaign between 1992 and 1995, placing greater emphasis on formal industry partnerships.

Surveys at the state level indicated increased awareness of the recommended daily amounts of fruit and vegetables, improved attitudes and increased consumption (Dixon *et al.*, 1998; Farrell *et al.*, 2000). A telephone survey of 2602 subjects in November 2000 showed an increase in reported consumption of fresh fruit and vegetables from 4.1 servings per day in 1998 to 4.5 (Reeve, 2000). In addition, respondents were aware of the health benefits of fruit and vegetable consumption and believed they should be eating seven or more servings per day.

Europe

Several campaigns have been conducted in Europe. The European Partnership for Fruits, Vegetables and Better Health (EPBH) is a voluntary network set up in May 2003 involving Denmark, Finland, France, Germany, Holland, Norway, Poland, Slovenia and the United Kingdom. The members are bodies promoting health or fruit and vegetable consumption. National members should ideally include both health organizations and non-profit organizations representing the fruit and vegetable industry, such as growers, importers, shippers, processors, wholesalers and retailers. Where such national partnerships do not exist, countries are encouraged to form such an alliance. The overall objective of EPBH is to assist members to increase the consumption of fruit and vegetables in their countries. This should be achieved by facilitating exchange of documentation and experience on effective strategies and actions and by collaboration and coordination of research activities on fruit and vegetable promotion across Europe. EPBH will formulate and communicate suggestions for policy changes at both national and European levels, coordinate pan-European promotions and actions and stimulate national partnerships between health partners and organizations representing the fruit and vegetable industry.

The EPBH web site (www.epbh.org) provides information on campaigns already implemented in European countries. As an example, the experience in Denmark, including some evaluation results, is summarized below.

In 1998, a broad consensus was reached in Denmark to adopt the message '6 A Day – Eat more fruits and vegetables' as the official national recommendation for fruit and vegetable consumption. A 2002 follow-up report from the Danish Ministry of

Food, Agriculture and Fisheries (Fagt *et al.*, 2002) confirmed 600 g/d in addition to potatoes as a recommended target for public health.

Since 1999, the Danish 6 A Day programme has conducted a number of research projects on how to increase fruit and vegetable consumption. A parent-paid subscription programme for fruit in schools was shown to increase students' fruit intake by 0.4 servings per day. Non-subscribers too showed a significant increase in fruit consumption in schools where the programme was introduced (Eriksen *et al.*, 2003).

Supplying free fruit in workplace settings has also proven very effective. In an intervention study, a total of 283 employees at 12 workplaces increased their average fruit intake by 0.7 servings per day and the men's intake of unhealthy snacks was cut in half (Morten Strunge Meyer, Denmark, personal communication). The number of workplaces offering free fruit to employees has greatly increased from 1998 to 2002.

Since 1998, the awareness of 6 A Day has been monitored twice a year. Unpublished data show that 40% of all Danes now know that they should eat 6 A Day or 600 g/d, and 66% have heard or read about the 6 A Day campaign. More important, the average *per capita* intake of fruit and vegetables for adults increased from 279 to 379 g/d from 1995 to 2000/01, according to the national dietary survey (Fagt *et al.*, 2002). Unpublished data from the 6 A Day telephone surveys suggest that this increase took place after the year 2000, when the 6 A Day-campaign was launched (Figure 15).

The 6 A Day research projects have shown that enhancing determinants such as availability and 'ready-to-eat-ness' can be very effective in increasing fruit and vegetable consumption in a population that already knows that fruit and vegetables are good for health. Health information has

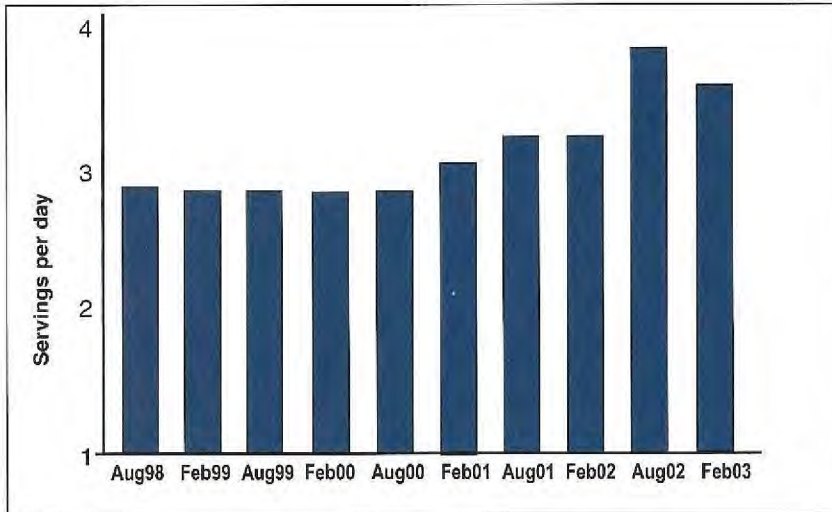


Figure 15 Self reported intake of fruits and vegetables in Denmark
Each bar is based on 500 phone interviews. Potatoes are excluded

not been entirely abandoned, continuing to target, for instance, key professionals, but for interventions to be effective the many and complex determinants must be adequately addressed when developing strate-

gies. 6 A Day's future strategy will have an increased focus on influencing health-oriented public policies and continued strengthening of effective public-private partnerships.

