

**Fruit and vegetable policy
in the European Union:
its effect on the burden of
cardiovascular disease**

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Introduction

There is a huge burden of cardiovascular disease (CVD) in Europe. CVD is responsible for 1.9 million (42% of the total) deaths in the European Union per year (Petersen, Peto et al. 2005). The World Health Organization (WHO) World Health Report 2003 reported that CVD makes up 16.7 million (29.2%) of total worldwide deaths, while in the European region¹ CVD was responsible for between 26.8% and 55.8% of total deaths (World Health Organization 2003). Although CVD mortality and incidence have been falling over the last 20 years in most northern, southern and western European countries, they are rising in many central and eastern European countries. CVD remains the leading cause of death in women in all countries of Europe, and in men for all countries except France and San Marino (Petersen, Peto et al. 2005).

Cardiovascular risk factors are well known and mostly amenable to change. Public health policies aimed at reducing rates of cardiovascular diseases have typically emphasised the traditional risk factors such as smoking, high blood pressure, elevated blood cholesterol and physical inactivity. Dietary interventions have tended to focus on reducing consumption of fat, in particular saturated fat, and salt. In the past less policy attention has been given to the impact of fruit and vegetable consumption. However, this is of growing importance as the nutrition transition, occurring in all but the poorest countries of the world, is resulting in the replacement of traditional plant-based diets rich in fruit and vegetables by diets rich in animal fats, salt and sugar, and low in complex carbohydrates (Popkin 2002). Dietary patterns across Europe, which once displayed cultural differences, are now converging.

The purpose of this paper is to examine the potential effect of the EU Common Agricultural Policy fruit and vegetable regime on the burden of CVD.

¹The WHO European region consists of 52 WHO member states that include Europe and Central Asia (<http://www.who.int/about/regions/euro/en/>)

1. The health benefits of fruit and vegetable consumption

International dietary goals

Awareness of the health benefits of fruit and vegetable consumption has been increasing in the last ten years, with clear evidence of their protective effect for coronary heart disease (CHD), stroke, diabetes, obesity and some cancers (WHO 2003; Lock, Pomerleau et al. 2004; Lock, Pomerleau et al. 2005), (Ness and Powles 1997), (World Cancer Research Fund and American Institute for Cancer Research 1997; International Agency for Research on Cancer 2003). In 2003 an international review panel for WHO and the Food and Agriculture Organization (FAO) assessed the strength of the evidence for the relationship between fruit and vegetable intake and health. They concluded that with an increased consumption of fruit and vegetables there is convincing evidence of reduced risk of CVD, a probable reduced risk of some cancers, diabetes and obesity, as well as an association with the prevention and alleviation of several micronutrient deficiencies (WHO 2003). The review panel recommended that a daily intake of fresh fruit and vegetables in an 'adequate quantity' is needed to reduce these disease risks. They defined an adequate quantity to be a minimum of 400 g per day.

This has led to current national and international recommendations proposing the intake of a minimum of 400 g of fruit and vegetables per person per day (excluding potatoes and other starchy tubers). In 2002, the European Heart Network position paper on food, nutrition and CVD prevention in the European region also proposed that for fruit and vegetable consumption the population dietary goal should be greater than 400 g per day (European Heart Network 2002).

Evidence for prevention of cardiovascular disease

Studies show that people who consume larger amounts of fruit and vegetables have lower rates of CHD and stroke (Ness and Powles 1997; Ness and Powles 1999). Even in people who already have developed CVD, dietary interventions suggest that eating more fruit and vegetables has beneficial effects in reducing rates of disease recurrence (Rinzler 1968; Singh 1992; de Logeril 1994). For example, the Lyon Diet Heart study showed that a traditional Mediterranean diet (which is high in fruits and vegetables, legumes, cereals and olive oil, and low in dairy and meat products) substantially reduced the risk of the reoccurrence and death from myocardial infarction compared with a low-fat diet only (de Logeril 1994). The results from an Indian study (Singh 1992) showed that the consumption of a low-fat diet enriched with fruit and vegetables compa-

red with a standard low-fat diet was associated with about a 40% reduction in cardiac events and a 45% reduction in mortality after one year. Results from the Dietary Approaches to Stop Hypertension (DASH) trial suggested that changes in dietary fats do not necessarily accompany an increase in fruit and vegetable intake. In this trial, people with high blood pressure were randomised to receive for eight weeks either a control diet, a diet rich in fruit and vegetables, or a combination diet rich in fruit and vegetables and reduced in saturated fat, fat and cholesterol (Conlin 2000), (Obarzanek 2001). Both the combination diet and the fruit-and-vegetables diet significantly reduced systolic and diastolic blood pressure. After eight weeks, 70% of the participants on the combination diet had a normal blood pressure, compared with 45% of those on the fruit and vegetable diet, and 23% of those on the control diet. It seems that the fruit and vegetable diet produced few changes in blood lipids, but was still likely to reduce CHD risk independently of dietary fat consumption.

Fruit and vegetable consumption in Europe

Although international recommendations propose a minimum intake of 400 g of fruit and vegetables per person per day, survey data and availability statistics from the United Nations FAO (Food and Agriculture Organization 2004) suggest that most populations are not meeting this goal (Lock, Pomerleau et al. 2005). In Europe, the consumption of fruit and vegetables is quite variable among countries. Only a few Mediterranean countries, such as Greece, where availability is high, are currently meeting the recommendation on a population level. But despite a relatively high mean consumption of 500 g per day in Greece, 37% of the population is still below the recommended 400 g per day level. This is disappointing considering that the climate and agricultural conditions in southern and central Europe are ideal for producing sufficient fruit and vegetables to feed the whole region year-round (Robertson, Tirado et al. 2004). Consumption clearly varies within countries between different social classes and age groups; surveys in 15 countries show that low income households have the lowest fruit and vegetable intakes (National Institute of Public Health 1999). In many European countries, population mean fruit and vegetable intake needs to double to meet health goals for all. (see table 1 for details of EU-15).

Table 1. In which of the former EU-15 Member States are people eating enough fruit and vegetables?

Target	Over 50% of population achieving target	Less than 50% of population achieving target
Fruit and vegetables: more than 400 g per day.	Greece (Crete), Italy, Portugal, Spain (Catalonia)	Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Netherlands, Sweden, UK.

Source: (Lobstein 2004)

2. The burden of cardiovascular disease due to low fruit and vegetable consumption in the European Union

Background

Although there is now increasingly good evidence that fruit and vegetables protect against cardiovascular diseases (CVD) and some cancers (World Cancer Research Fund and American Institute for Cancer Research 1997; WHO 2003), (Riboli and Norat 2003), their precise contribution to the overall burden of disease has only recently been established. Early studies estimated that low fruit and vegetable consumption was responsible for 2.4%, 2.8% and 3.5% of the burden of disease in New Zealand (Tobias 2001), Australia (Mathers 1999) and the EU-15 (National Institute of Public Health 1997) respectively. Findings from the WHO Global Burden of Disease study (2002) suggest that 4.4% of the total burden of disease in Europe² could be attributed to low fruit and vegetable intake, compared to 7.8% attributable to overweight and obesity. This study also estimated that the current low fruit and vegetable intake causes up to 31% of heart disease and 19% of stroke (WHO 2002).

A previous study has reported that 23 000 premature deaths (before the age of 65) from cardiovascular diseases and major cancers could be prevented in the EU-15 if mean fruit and vegetable consumption was increased to the minimum recommended level (Joffe and Robertson 2001). On 1 May 2004, the European Union (EU) underwent an unprecedented enlargement, from 15

²The WHO European region consists of 52 WHO member states that include Europe and Central Asia (<http://www.who.int/about/regions/euro/en/>). For the Global Burden of Disease Study the European region was subdivided into 3 sub-regions (A, B and C) for analysis depending on socio-economic development.

to 25 countries, increasing its population by 20% to more than 450 million. This enlargement is important not only because of its scale but also because of the gap in health status between the existing and new Member States. In the light of this, the European Heart Network commissioned a new analysis of the burden of CVD due to low consumption of fruit and vegetables for all 25 countries in the expanded European Union (EU-25)³.

Methods

The burden of CVD in the EU-25 was estimated for an aggregate measure of 'fruit and vegetable intake' which was defined as being total fruit and vegetable consumption, excluding potatoes to be consistent with current international recommendations (World Health Organization 1990; World Cancer Research Fund and American Institute for Cancer Research 1997; WHO 2003). Four sources of information were combined to derive the disease burden attributable to current low fruit and vegetable intake in the EU:

- Information on the level and distribution of fruit and vegetable consumption in the population of the EU-25;
- A 'target' level of fruit and vegetable consumption that would yield the lowest overall population risk of CVD. Two population targets were selected for the analyses, 400 g per day (the minimum goal) and 600 g per day (an ideal goal representing the highest levels of consumption in the EU);
- Quantitative estimates of the association between fruit and vegetable intake and selected CVD (coronary heart disease and stroke);
- Most recent estimates of the disease burden for coronary heart disease (CHD) and stroke in the EU-25 (provided by Colin Mathers, WHO Geneva).

The burden of disease analysis involved estimating population attributable fractions (PAFs) for both CHD and stroke. The attributable fraction is defined as the percentage reduction in disability and death that would occur if fruit and vegetable consumption increased from the current levels to the defined target level that would yield the theoretical lowest population risk (Ezzati, Lopez et al. 2002; Ezzati, Vander Hoorn et al. 2003; Ezzati, M., Lopez, A.D. et al. 2004). Disability adjusted life years (DALYs) were estimated as a measure of the burden of disease on the EU population. They combine years of life lost and years lived with a disability, and are used as a valid summary indicator of population health. A fuller description of the methods and data sources is given in Appendix A.

³The EU-25 countries are Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Latvia, Luxembourg, Malta, The Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, the United Kingdom

Results

The main results are presented in Tables 2 and 3. Estimates broken down by age group and gender are included in Appendix B.

The findings show that low fruit and vegetable intake in the EU is a major cause of disability and death due to coronary heart disease and stroke. If all 25 countries in the expanded EU were able to increase fruit and vegetable intake to the minimum recommended levels of 400 g per person per day (Table 2), this could prevent up to 7% of CHD and 4% of stroke. However, it must be remembered that 400 g per day is the lowest dietary goal. If people across the EU started to consume the same amounts of fruit and vegetables as are eaten by the highest consuming countries such as Spain or Italy, we might be able to reduce the risk of CHD by up to 18% and stroke by 11% (Table 3). This could prevent over 135 000 deaths from CVD each year. This contrasts with the burden of disease due to food safety issues. Although the rates of food-borne infections are rising in Europe (BfR 2003), unsafe food and food-borne disease cause a much smaller proportion of the total burden of ill health and lead to very few deaths (Robertson, Tirado et al. 2004). It is clear that promoting healthy diets, including high consumption of fruit and vegetables and low consumption of saturated fats, is the most important food and nutrition issue that needs to be tackled at EU level.

Table 2. The burden of cardiovascular disease that could be reduced if fruit and vegetable intake in the European Union (EU 25) increased to 400 g per day (i.e. the minimum recommended level)

	Coronary Heart Disease			Stroke		
	Men	Women	Total	Men	Women	Total
Attributable deaths	24 122	16 669	40 791	4 117	5 434	9 551
Attributable DALYs	217 098	90 335	307 434	50 477	41 979	92 456
Attributable burden of disease (%)	7.7	5.8	7.1	4.5	3.7	4.1

Table 3. The burden of cardiovascular disease that could be reduced if fruit and vegetable intake in the European Union (EU 25) increased to 600 g per day (i.e. levels eaten in high-consuming countries such as Spain)

	Coronary Heart Disease			Stroke		
	Men	Women	Total	Men	Women	Total
Attributable deaths	61 670	46 666	108 336	11 018	15 650	26 668
Attributable DALYs	523 985	243 022	767 007	126 598	115 742	242 340
Attributable burden of disease (%)	18.7	15.7	17.6	11.2	10.2	10.7

3. The European Union Common Agricultural Policy (CAP): Common Market Organisation for fruit and vegetables

The European Union (EU) produces about 9-10% of the world's total production of fruit and vegetables (European Commission DG Agriculture 2003). It is the world's largest importer of fruit and vegetables and the second largest exporter. The fruit and vegetable sector uses about 4% of the EU's utilised agricultural land (European Commission DG Agriculture 2003), accounting for about 3.7% (euro1 650 million) of the agriculture budget, and 15% of the total value of agricultural production in the EU in 2002 (European Commission DG Agriculture 2003; Schafer Elinder 2003). In the EU-15 the total production of vegetables had been reasonably stable for several years. In 2001-2002, vegetable production was 55 million tonnes and the total fresh fruit production was 57 million tonnes (European Commission DG Agriculture 2003). The ten new Member States together produce 9 million tonnes of vegetables and 6 million tonnes of fruit, with Poland being the main producer. European demand has also remained stable at about 41 million tonnes of vegetables (approximately 133 kg per person per year) and 29 million tonnes of fruit (approximately 92 kg per person per year).

A common market organisation (CMO) (or 'regime') for fresh fruit and vegetables was initially set up in 1962, and a regime for processed fruit and vegetables has developed since 1968. Within

the CAP, several policy mechanisms exist through which the EU can intervene on the agricultural market to affect the quantity of production and the price of a commodity. For fruit and vegetables the two mechanisms used are (Schafer Elinder 2003):

- withdrawal of produce from the market at certain levels;
- the use of import tariffs.

These measures artificially maintain prices above the world market level and thus ensure a guaranteed income for farmers, one of the objectives of the CAP.

Reforms of fruit and vegetable sector in the EU CAP

In 1996, the fruit and vegetable sector was reformed (Council Regulation (EC) No. 2200/96 of 28 October 1996; Council Regulation (EC) No. 2201/96 of 28 October 1996; Council Regulation (EC) No. 2202/96 of 28 October 1996). This aimed to give more responsibility to producers to handle and distribute withdrawn produce and to reduce the levels above which no withdrawal support payment can be obtained (Schafer Elinder 2003). The EU has provided financial assistance to recognised producer organisations to set up and become a major means to market fruit and vegetables. The objective is that by grouping together producers can strengthen their position, and deal with the increasingly concentrated demands of the supermarket retail sector and the processing industry. In the EU-15 nearly 1 400 producer organisations channelled about 40% of all fruit and vegetable production to market in 2002 (European Commission DG Agriculture 2003); however, the coverage of producer organisations varies across the EU, and is virtually non-existent in the new Member States.

As a result of the reforms, the role of subsidised withdrawals of produce from the market has been significantly reduced so that production is more oriented to market demand rather than merely benefiting from CAP support systems. From 1993-1996 the withdrawal quantity halved and it was expected to reach the lowest level in the market year 2002/2003 where the withdrawal ceilings reached their lowest levels (Schafer Elinder 2003). In 2002, withdrawals had fallen to 0.6 million tonnes of fruit and vegetables at a cost of euro 61 million.

Withdrawn produce should only be used for certain purposes such as free distribution via charities as first choice, disposed of as animal feed, distilled for alcohol, or destroyed as a last resort. Currently up to 80% of withdrawn produce is destroyed and only about 5% is actually going back

into the human food chain (Schafer Elinder 2003). Although it is recognised that there are limitations, as some fruits and vegetables are perishable, the current practice is clearly not in line with the EU's regulation.

A revision of the fruit and vegetable regime entitled 'simplification of the CMO in fruit and vegetables' was undertaken in 2004. A report from the Commission on the proposals to the Council and the Parliament was published in August 2004 (Commission of the European Communities 2004). Although this process has the potential to create opportunities for the health sector to work with the agriculture sector for mutual gains, the strategic questions raised in the report have little or no relevance to public health. The only health issues that have been put forward are not new and focus solely on the demand side. The proposals mention the need for 'promoting consumption of fruit and vegetables', and they 'invite the Commission to introduce a school fruit scheme to reach young people'.

On 22 November 2004 the Dutch Presidency adopted the conclusions of this report (Council of the European Union 16 November 2004). The European Parliament will adopt its opinion in May 2005. It is planned that the Court of Auditors will adopt a preliminary report on fruit and vegetable producer organisations and operational fund functioning in June 2005. After this the Commission will develop and present legislative proposals. The proposals presented in 2004 are currently a missed opportunity for improving public health as they continue to focus on simplifying the CMO in order to make it more market oriented.

4. The effect that the Common Agricultural Policy on fruit and vegetable consumption has on public health

Increased production and stimulating demand

The CAP has several policy mechanisms through which the EU can intervene on the agricultural market to affect the quantity of production and the price of a commodity. The fruit and vegetable sector reforms have served to reduce the quantity produced, in order to reduce the amounts of produce withdrawn (see section 3). This CAP measure was designed to maintain production prices, and is not inherently due to a lack of demand for fruits and/or vegetables in Europe. In fact, as the world's largest importer, there is considerable potential for EU fruit and vegetable production to expand to supply the European market. It seems logical that production could best be increased if a multi-systems approach were undertaken, with the agriculture and health sectors working together to simultaneously increase supply and demand. This multi-sector approach has been advocated by a new international fruit and vegetable promotion initiative jointly launched by the WHO and UN FAO in November 2003 (WHO 2003), as part of the Global Strategy on Diet, Physical Activity and Health. Such approaches could support a range of strategies to increase fruit and vegetable demand. For example, government policy could advocate public sector procurement of local fruits and vegetables (and other foods), and ensure that publicly funded meals meet minimum dietary goals. In addition, fruit and vegetables are often promoted in both the health and agricultural sectors, yet there is little coordination of initiatives or resources for maximum effect.

Price

There is some evidence to suggest that the consumption of fruit and vegetables is price sensitive. This means that people would potentially eat more if prices were lower and availability increased. For example in France fruit and vegetables, meat, poultry, eggs, fish and cheese have greater expenditure elasticity (i.e. expenditure on a product relative to increases in total food expenditure) than dairy products, butter, oils and grain products (Nichele 2003). These 'price elasticities' are likely to vary to some extent across European countries. In a 'pure' market, changes in consumer purchasing would be transmitted back to producers, to drive changes in production. The CAP, with its subsidies and market support schemes, creates an artificial market and distorts this (Lobstein 2004). The CAP has an effect on the price at which fruit and vegetables are sold

on the market. The use of withdrawal compensation and import tariffs imposed on countries outside of the EU artificially maintains prices at a higher level than if there were no such market support mechanisms.

It is less obvious, however, what the exact nature of the relationship between the CAP fruit and vegetable policy and the price of fruit and vegetables sold across Europe is due to the dominance of a small number of large food companies in the retail sector (Lang and Heasman 2004). However, it does not appear to be in the interest of consumers, especially low-income households, which currently have the lowest intakes and the worst health (National Institute of Public Health 1999), to have prices of fruits and vegetables maintained at an artificially high level through the use of CAP price support measures.

A Swedish Public Health report on the CAP (Schafer Elinder 2003) has called for all fruit and vegetable withdrawals to be suspended in the EU. This proposes that lower production prices would lead to lower consumer prices, which should stimulate increased purchase of fresh produce by consumers, and in turn establish higher market demand. However, this does not fully take into account the current power of the supermarket sector in Europe, and assumes that the retail sector would not take advantage of such an opportunity to increase revenues.

Removing other CAP disincentives to fruit and vegetable growing

The June 2003 CAP reform actually created a disincentive to fruit and vegetable growing. This introduced a single farm decoupled payment for growers of cereals, beef and several other commodities, allowing farmers to change the type of crop grown or not to grow anything at all without loss of subsidies (European Commission 2003). However, fruit and vegetable growing is excluded. This means that farmers wishing to switch their land use to growing fruit and vegetables will be penalised (compared to farmers of other crops), as they are therefore not entitled to receive the new single payment. The only exception to this is the new Member States, which have an exemption until 2008. This policy disincentive should be changed to encourage and not discourage horticultural production.

Using withdrawn produce for human consumption

It would be preferable if the EU did not intervene on the market by withdrawing fruit and vegetables at certain price levels. However, until any further changes are made to the CAP intervention

mechanisms it is particularly important that the current fruit and vegetable sector increase the amount of any withdrawn produce supplied for human consumption. It should particularly aim to target those who eat less fresh fruit and vegetables, such as children and low income groups. In the dairy sector, some of the excess milk produced and withdrawn from the market is used to supply school milk schemes. It seems logical that a similar scheme could be set up for supplying school fruit and vegetable schemes. The infrastructure already exists in many places to support this, either via the supply chain for school milk schemes, or via existing fruit in school schemes (for example, in the United Kingdom and Denmark). Increasing fruit and/or vegetables in schools could also lead to an increase in the demand for fruit and vegetables more widely in the population (as has been shown in the evaluation of a Danish School Fruit subscription programme) (Eriksen 2003). Fruit in school schemes, if they lead to substitution for intake of high sugary, salty and fatty snacks in schools, may be one mechanism for starting to address the worrying rise in childhood obesity in the EU, which will only worsen population cardiovascular disease rates in the future.

Other public health considerations

It is important to consider the links between the EU CAP fruit and vegetable regime and broader population health issues. Many governments continue to rely on health education as the main strategy to increase fruit and vegetable intake. Although health education promoting 'fruit and vegetables as part of healthy diets' is an important pillar for improving public health, it cannot tackle the growing burden of food-related ill-health on its own. Moreover, currently only a small budget inside the EU and the CAP is allocated for health education and promotion of fruit and vegetables. This is unable to compete with the large global marketing budget for food promotion. It has been estimated that for every dollar the WHO spends on non-communicable disease programmes, food companies are spending \$500 on marketing their products – mostly high in fats, sugar and/or salt, and low in fresh fruit or vegetables (Lobstein 2004).

Interestingly, the European Commission wants to improve the relationship between the fruit and vegetable regime and the Rural Development policies in the CAP (Commission of the European Communities 2004). Increasing production of fruit and vegetables may deliver socio-economic benefits for rural populations as the horticulture sector is more labour intensive (on average employment levels are 5-10% higher) than the overall agriculture sector, thus helping the unemployment situation in rural communities and creating a source of income-diversification for smaller-scale farmers (Bryden and Robertson 2004). This could benefit public health, and specifical-

ly cardiovascular health, due to the clear links between low socio-economic status and cardiovascular risk (European Heart Network 1998). The CAP should establish mechanisms to ensure that small farmers and the rural poor benefit to the same extent as large scale producers. For example, local food chain distribution systems could be established with the aim to work with growers, processors, and smaller retailers to get products to consumers, reducing the dominance of a few large supermarkets across Europe and increasing competition and choice locally.

Even though some broader public health issues are raised here it is important to remember that the most important population health impacts of the CAP remain through the influence on the dietary determinants of chronic disease.

Conclusions and recommendations

In Europe the main emphasis of food policy tends to be on food safety, which is considerably less important than non-communicable diseases in terms of disease burden. A growing number of international organisations are advocating an increase in fruit and vegetable intake to a minimum of 400 g per day (excluding potatoes) (World Health Organization 1990; World Cancer Research Fund and American Institute for Cancer Research 1997). This has been translated into some national health promotion campaigns including the '5 a day' programmes in Germany, Poland, Spain, Sweden, the United Kingdom, '6 a day' in Denmark and '10 a day' in France (Pomerleau, Lock et al. 2004) (Department of Health 2000; Centers for Disease Control 2002) and equivalent marketing-based initiatives in other countries (e.g., '3 a day' in Hungary).

The new estimates of the burden of disease in the EU-25 presented here suggest that the 400 g per day target should be the minimum policy goal for reducing cardiovascular disease rates. However, this will require wide-ranging changes in many policy sectors as current programmes on their own have had only limited success in increasing fruit and vegetable intake in the face of competing pressures, such as intensive marketing of fast food. As dietary habits are deeply embedded in the cultural, economic and political structures there should also be greater emphasis on promoting policies that target the determinants of fruit and vegetable consumption rather than simply focusing on health education, targeting individual behavioural change. Policy should aim to remove obstacles and to enhance people's ability to eat healthy diets. This needs to include action on the European Union CAP as proposed here. Despite the potential health gains possible through increasing fruit and vegetable consumption, the effect of the CAP has actually been the reverse, i.e. increasing prices and reducing availability of fruit and vegetables for consumers.

Recommendations

The simplification of the fruit and vegetable common market organisation in the EU presents an opportunity for inter-sectoral approaches to offer benefits to consumers and farmers alike, while improving the health of the European population. The proposals presented in 2004 are currently a missed opportunity as they focus on simplifying the CMO in order to make it more market oriented, with only token mention of the need to promote fruit and vegetable consumption. In order to achieve public health gains there are key issues that this process should tackle, which include:

- The fruit and vegetable regime should promote the reduction and eventual phasing out of withdrawal compensation. This could lead to falling prices which could stimulate purchase and consumption of fruit and vegetables.
- In the short term, any withdrawn produce should be used for human consumption. It should particularly aim to target those who eat less fresh fruit and vegetables, such as children and low income groups.
- The single farm payment scheme should be extended to include fruit and vegetables.
- Efforts to promote fruit and vegetables should be coordinated between the health and agricultural sectors for maximum effect.

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Appendix A. Details of the methods used for estimating the burden of disease due to low fruit and vegetable consumption in the European Union

In this study we estimated the burden of disease due to an aggregate measure of 'fruit and vegetable intake' which we defined as being total fruit and vegetable consumption, excluding potatoes (World Health Organization 1990; World Cancer Research Fund and American Institute for Cancer Research 1997; WHO 2003). Fruit and vegetable intake was treated as a continuous variable and expressed in grams per person per day.

Estimates of consumption were based primarily on national representative surveys of individual dietary intake identified through a comprehensive search of the literature and contact with experts in Europe. Surveys with individual level dietary data provide information on intakes and their variability (standard deviations) in population sub-groups (by age and sex strata). Data were obtained for 11 countries (see table A1). Full details have been published elsewhere (Pomerleau, Lock et al. 2004).

When no survey data was available in a country, estimates of fruit and vegetable intakes were derived by the use of systematic extrapolations from per capita food supply statistics from the UN FAO15 in a model based on survey data from other countries in the European Union. The FAO collects food balance data each year from virtually all countries in the world using a standardised approach (Kelly, Becker et al. 1991). FAO data (for the year 2000) (Food and Agriculture Organization 2004) on fruit (excluding wine) and vegetable (excluding potatoes) availability and population size estimates (for the year 2000) (United Nations Population Division 2002) were used to calculate regional population-weighted average fruit and vegetable per capita availability. Food consumption estimated from FAO supply figures are not the same as actual dietary consumption statistics, but they can be linked using correction factors. These are obtained using dietary surveys from Member States, and comparing these with food supply figures during the same period. In this analysis we used 33% as an estimate of the correction factor for the European Union, derived from the published literature (Joffe and Robertson 2001). Standard deviations were applied from the survey data that had been obtained for 11 of the 25 European Union countries.

Table A1. Details of dietary intake surveys included

Country	Contact/ Reference	Name of survey (if any)	Sample	Dietary data collection method	Year	Sample size	Sex	Age range
Belgium	(De Henauw 2001)	Belgian Interuniversity Research on Nutrition and Health	Random sample form voting lists in 42 out of 43 Belgian Districts	One 24-hr recall	1980-84	22 224	MF	25–74 yrs
Denmark	(Fagt 2001)	Dietary habits in Denmark	Random sample from Central Population register	7-day food record	1995	3 098	MF	1–79 yrs
Estonia	(Pomerleau 2001)	Baltic Nutrition Survey	Random sample from the National Population Register	One 24-hr recall	1997	2 108	MF	18–65 yrs
Finland	(Findiet Study Group 1998)	Dietary Survey of Finnish Adults	Random sample (age stratified), cross-sectional- 5 subregions	One 24-hr recall	1997	3 153	MF	25–74 yrs
France	(Volatier 1999)	INCA: Enquête Individuelle et Nationale sur les Consommations Alimentaires	Representative national sample	7-day food record	1998-99	3 003	MF	3+ yrs
Germany	(Mensink 2001)	German Nutrition Survey	Representative national sample	Dietary history	1998	4 030	MF	18–79 yrs
Ireland	(Friel 2001)	National Health and Lifestyle Survey	Two-stage sampling using Irish Electoral register	Semi-quantitative food-frequency questionnaire	1998	6 332	MF	18+ yrs
Italy	(Turrini 2001)	INN-CA – Nation-wide Nutritional Survey of Food Behaviour of the Italian Population	Multistage random sample of households with subregional stratification	7-day food diaries	1994-96	2 734	MF	0+ yrs
Latvia	(Pomerleau 2001)	Baltic Nutrition Survey	Random sample from the National Population Register	One 24-hr recall	1997	2 308	MF	18–65 yrs
Lithuania	(Pomerleau 2001)	Baltic Nutrition Survey	Random sample from the National Population Register	One 24-hr recall	1997	2 153	MF	18–65 yrs
United Kingdom	(Gregory 1990; Gregory 1995; Finch 1998; Gregory 2000)	National Diet and Nutrition Survey (four surveys)	Nationally representative random sample from postcode address files	7-day weighed record (4 days for under 5 yrs)	1986-2000 4 surveys	Each survey ~2 000	MF	1.5–4.5/ 4–18 / 16–64 / >65 yrs

The health outcomes selected included CHD and cerebrovascular disease. Relative risks for these health outcomes were obtained from systematic reviews of the literature conducted for each disease outcome using standardised methods with the results pooled using meta-analysis (see table A2). Complete details of the methods used for estimating relative risks are published elsewhere (Lock, Pomerleau et al. 2004).

Table A2. Relative risks of the relationship between intake of fruit and vegetables and cardiovascular disease (and 95% confidence intervals) by age group

Outcome	Age group (years)							
	0-4	5-14	15-29	30-44	45-59	60-69	70-79	80+
Coronary heart disease	1.00	1.00	0.90 (0.82-0.99)	0.90 (0.82-0.99)	0.90 (0.82-0.99)	0.90 (0.82-0.99)	0.93 (0.85-1.01)	0.95 (0.87-1.03)
Ischaemic stroke	1.00	1.00	0.94 (0.89-0.99)	0.94 (0.89-0.99)	0.94 (0.89-0.99)	0.94 (0.89-0.99)	0.95 (0.91-1.00)	0.97 (0.92-1.02)

Unit of change in risk is change per 80g/d increase in fruit and vegetable intake

The burden of disease analysis involved estimating population attributable fractions for both CHD and stroke. The attributable fraction is defined as the percentage reduction in disability and death that would occur if fruit and vegetable consumption reached a defined level that would yield the theoretical lowest population risk (Ezzati, Lopez et al. 2004). Hence, the attributable burden of disease is defined as the difference between the currently observed disease burden and the burden that would be observed if the population fruit and vegetable consumption met this baseline of choice (Ezzati, Lopez et al. 2002; Ezzati, Vander Hoorn et al. 2003). Disability adjusted life years (DALYs) were estimated as a measure of the burden of disease on a defined population. They combine years of life lost and years lived with a disability, and are used as a valid summary indicator of population health.

Fruit and vegetable intake is unusual in that it is the potential protective effect of fruit and vegetables that is considered. Hence, the theoretical minimum risk involves a plausible maximum level of fruit and vegetable consumption level at which the protective effect is maximised. Although eating more fruit and vegetables is clearly related to reduced rates of disease, the

levels of intake that would give the greatest protection remain unclear at present. We estimated the burden of disease if the European Union population increased its mean consumption to two different levels:

- The minimum international recommended fruit and vegetable daily consumption (400 g per day) or
- The highest levels of fruit and vegetable intake currently estimated to be achieved in the European Union (600 g per day). This higher goal reflects two factors: how high do benefits continue, and what level of consumption can we assume (even in theory) to be achievable.

Appendix B. Burden of cardiovascular disease: by age and gender

Figures B1-B6 give results for the numbers of lives from CHD and stroke that could be saved and the estimated reduction in the burden of these diseases in the European Union in 2000 if fruit and vegetable consumption increased to at least 400g/d or to at least 600g/d.

Figure B1. Number of lives that could be saved from CHD in the European Union if fruit and vegetable consumption increased to at least 400g/d or to at least 600g/d, by age and gender (figures for the year 2000).

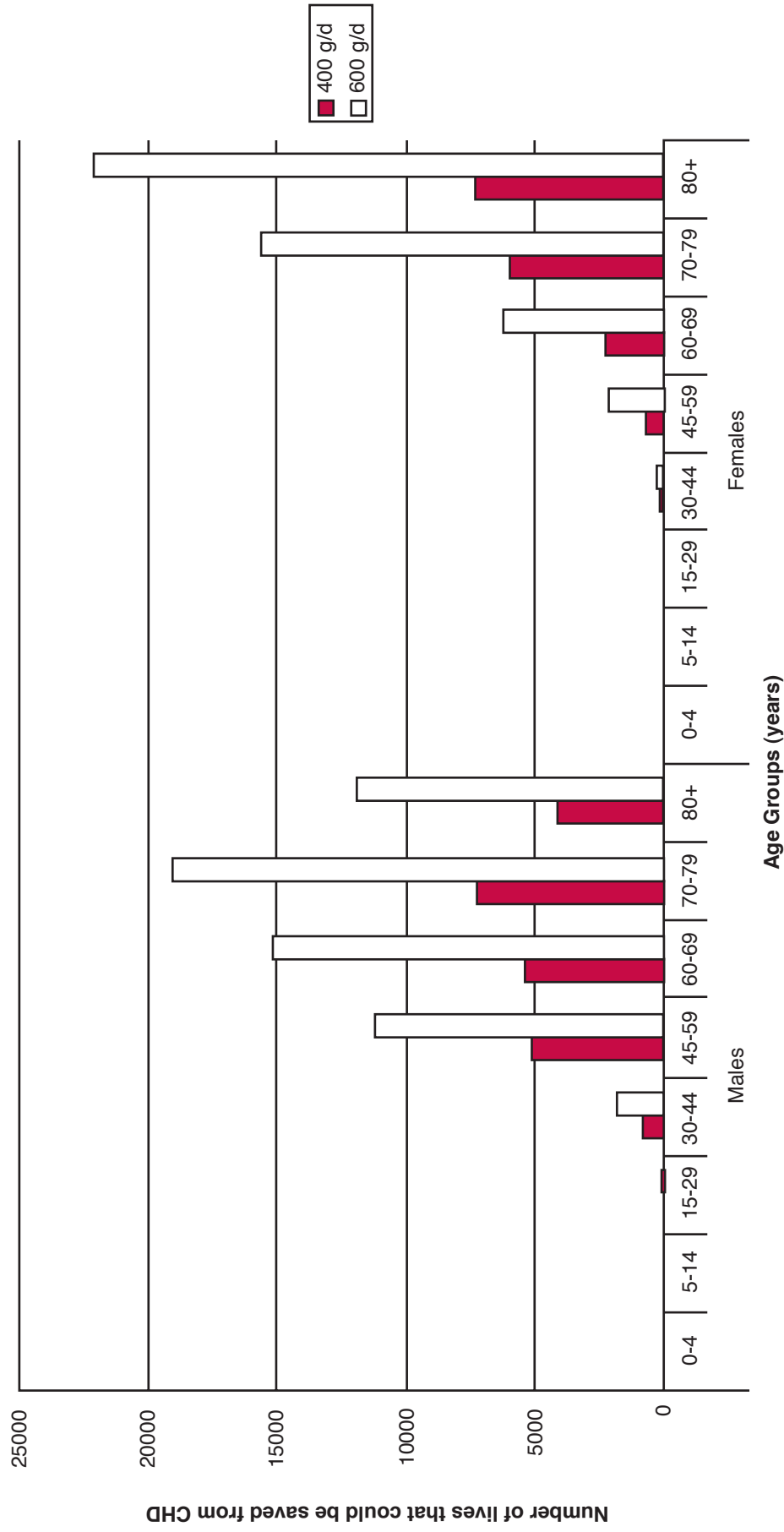


Figure B2. Estimated reduction in the burden of CHD (expressed in disability-adjusted life year, DALY) in the European Union that could be achieved if fruit and vegetable intake increased to at least 400g/d or to at least 600g/d, by age and gender (figures for the year 2000).

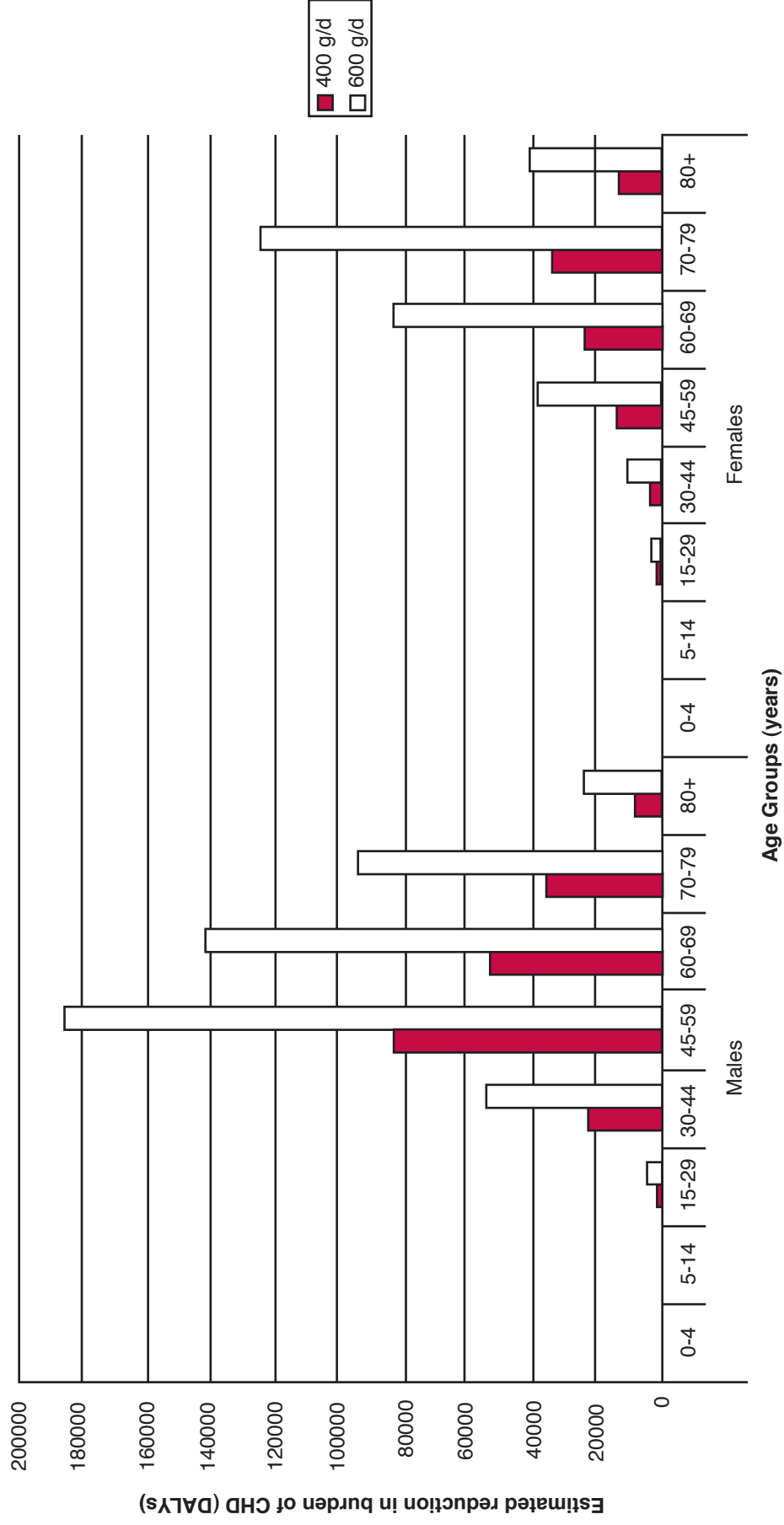


Figure B3. Estimated percent reduction in the burden of CHD (expressed as a proportion of total burden of CHD) in the European Union that could be achieved if fruit and vegetable intake increased to at least 400g/d or to at least 600g/d, by age and gender (figures for the year 2000).

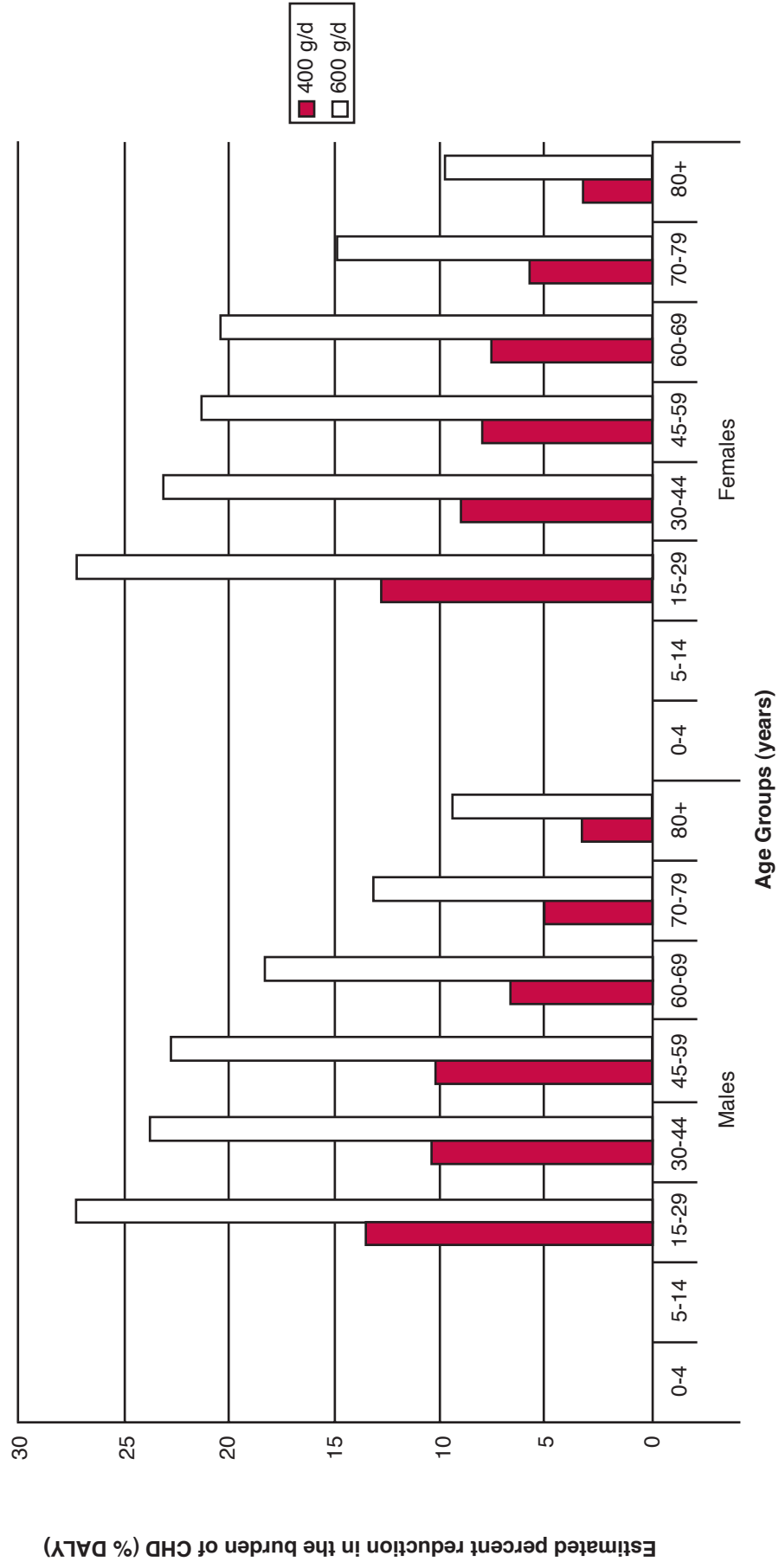


Figure B4. Number of lives that could be saved from stroke in the European Union if fruit and vegetable consumption increased to at least 400g/d or to at least 600g/d, by age and gender (figures for the year 2000).

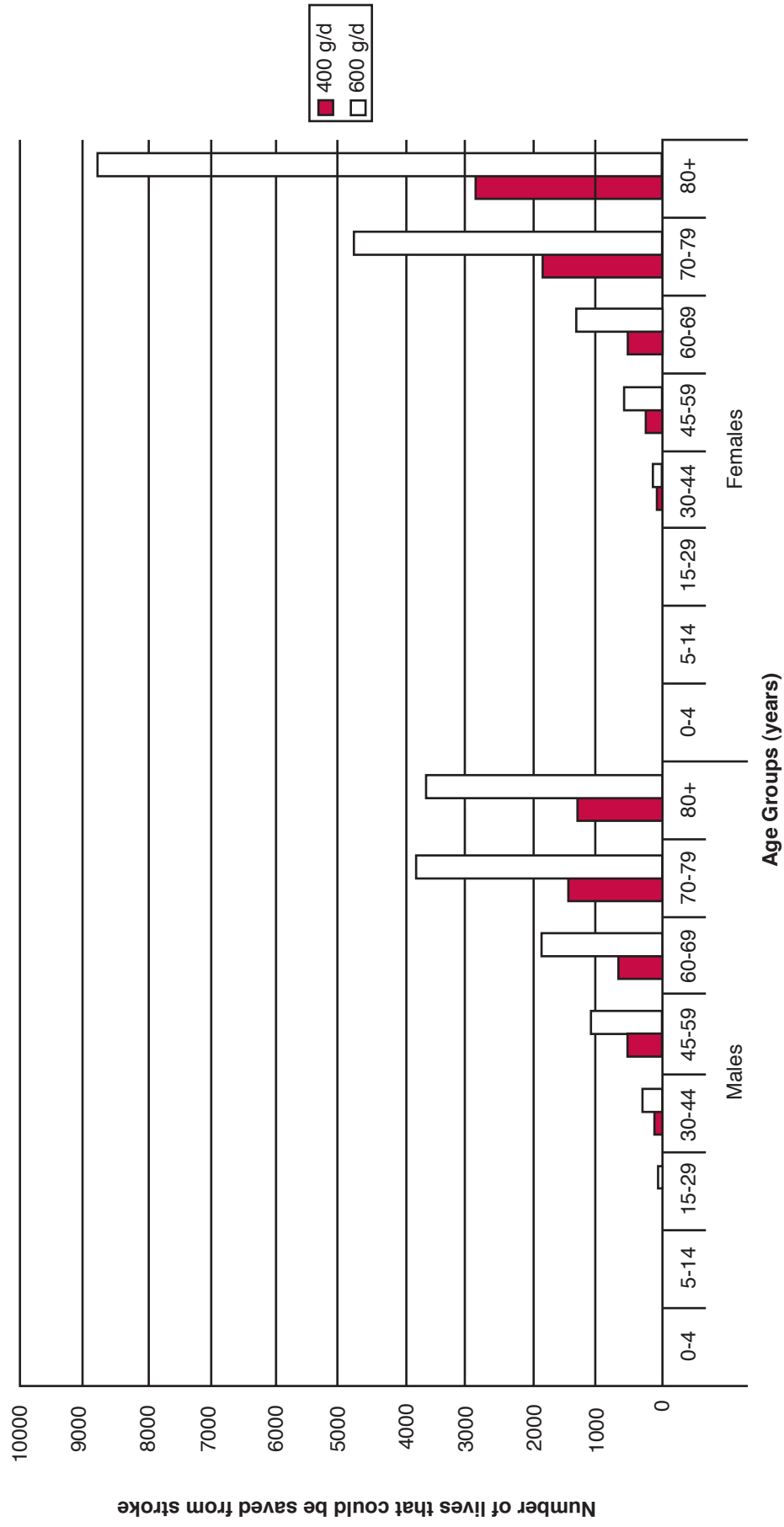


Figure B5. Estimated reduction in the burden of stroke (expressed in disability-adjusted life year, DALY) in the European Union that could be achieved if fruit and vegetable intake increased to at least 400g/d or to at least 600g/d, by age and gender (figures for the year 2000).

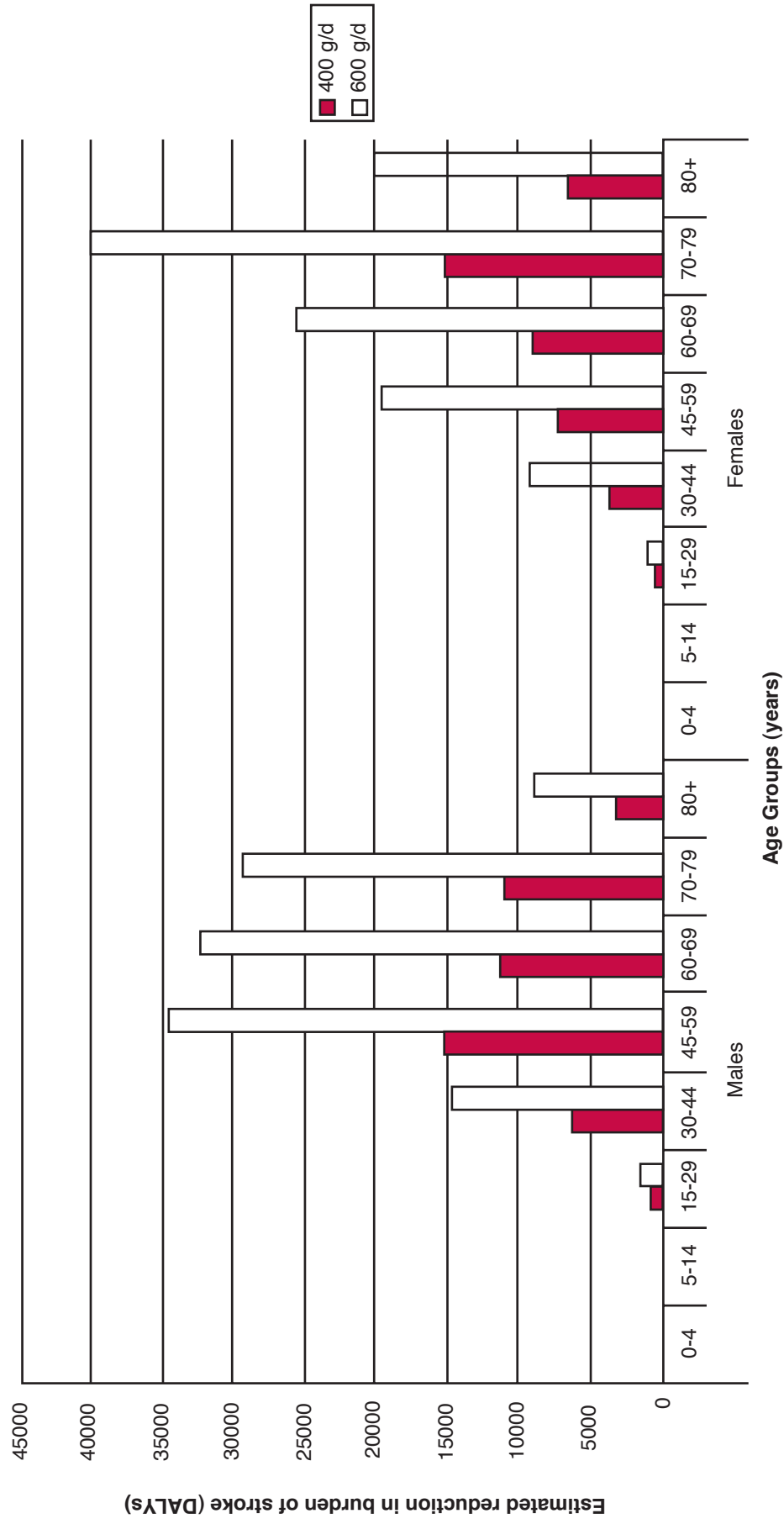


Figure B6. Estimated percent reduction in the burden of stroke (expressed as a proportion of total burden of stroke) in the European Union that could be achieved if fruit and vegetable intake increased to at least 400g/d or to at least 600g/d, by age and gender (figures for the year 2000).

