



### Key messages

- ▶ A high level of fruit and vegetable consumption may prevent chronic diseases.
- ▶ Most women and men do not eat the recommended daily portions of fruit and vegetables.
- ▶ Adolescents reach the recommended portions of vegetables more often than younger children.
- ▶ A large part of Germans consume at least three portions of fruit and vegetables per day.
- ▶ On average, women eat more portions of fruit and vegetables per day than men.
- ▶ The number of daily portions of fruit and vegetables consumed by men is higher at older age.

## Fruit and vegetable consumption today

Fruit and vegetables are important sources of vitamins, mineral nutrients, dietary fibres and phytochemicals for the human organism. They usually have a high water content and contain relatively few calories per unit of volume. Together with the fibre they contain, this leads to a relatively good satiety effect, despite a comparatively low energy intake. Including a high proportion of such plant-based foods in one's daily diet can thus avoid an excessive intake of nutritionally less useful foods and in this way help optimize the energy and nutrient balance (DGE 2007).

Based on many studies, a high level of fruit and vegetable consumption is regarded to be an important factor in the prevention of several chronic diseases (WHO, FAO 2003; WCRF, AICR 2007; Boeing et al. 2007). However, dietary recommendations based on corresponding studies have not been followed by the majority of the German population over the last decades (RKI 2002; Adolf et al. 1995). Various public health measures have therefore been in force for some time trying to increase the amount of fruit and vegetables consumed by children, adolescents and adults. Probably one of the best known activities is the »5 am Tag« (5-a-day) campaign, which since 2000 has been encouraging the consumption of five portions of fruit and vegetables a day. Since 2008, the IN FORM National Action Plan – »Germany's initiative for a healthy diet and more physical exercise« – has been trying to increase fruit and vegetable consumption in the country by measures of structural and behavioural prevention targeting daycare centres, schools, families and the workplace. Furthermore, EU-funded school fruit programmes – in which children receive one free portion of fruit or vegetables a day – have been running in seven German states since 2010 (BMELV 2011; IN FORM 2011; 5 am Tag e.V. 2010).

Recent representative data can be used to determine the extent to which fruit and vegetable consumption has improved and whether further preventive measures are needed. This issue therefore describes results of the Robert Koch Institute's 2009 »German Health Update« (GEDA) study and the 2006 »Nutrition Study as KiGGS Module« (EsKiMo) on fruit and vegetable consumption. To sketch the background for the empirical data, we first provide some information on the evidence supporting a link between fruit and vegetable consumption and certain chronic diseases, summarize agricultural-statistical trends in the consumption of fruit and vegetables over the last years, and give an overview of age-specific dietary recommendations.

### Fruit and vegetables offer proven protection against chronic diseases

Eating fruit and vegetables has an influence on physiological processes which can reduce the risk factors of a wide range of chronic diseases. The positive effects

### Fruit and vegetables

Fruit is defined as the edible seed-bearing part of mostly perennial plants. Vegetables are annual or biennial plants, most of which are only harvested once; either the whole plant or its vegetative parts (e.g. roots, shoots, leaves) are eaten (Belitz et al 2007).

However, specific (often regional) eating habits can lead to deviations in the application of these biological definitions. For example, in Germany potatoes are not regarded as vegetables, but as a staple food or a »filling side dish«. Tomatoes and cucumbers, by contrast, are regarded as vegetables although they are fruits, and rhubarb as a fruit although it is a vegetable. Such inconsistencies make dietary assessments – and international comparisons – more difficult.

include improving the lipoprotein profile, reducing hypertension and atherosclerosis, and lowering elevated homocysteine levels (He et al 2006; Bazzano et al. 2003). Various expert bodies have assessed the scientific evidence behind the claim that consuming high amounts of fruit and vegetables offers protection against certain diseases and categorized it according to evidence grades (Tables 1 and 2).

There is convincing evidence that a high level of fruit and vegetable consumption reduces the risk of coronary heart

**Table 1**  
Evidence of correlations between fruit and vegetable consumption and protective effects vis-à-vis certain non-communicable diseases\*

	Fruit and vegetables	Fruit	Vegetables
Coronary heart disease	xxx <sup>d</sup>		
Hypertension	xxx <sup>d</sup>		
<b>Cancer</b>			
Mouth	xx <sup>b</sup>	xx <sup>c</sup>	xx <sup>c</sup>
Pharynx	xx <sup>b</sup>	xx <sup>c</sup>	xx <sup>c</sup>
Nasopharynx		x <sup>c</sup>	x <sup>c</sup>
Larynx	xx <sup>b</sup>	xx <sup>c</sup>	xx <sup>c</sup>
Oesophagus	xx <sup>b</sup>	xx <sup>c</sup>	xx <sup>c</sup>
Lung		xx <sup>b, c</sup>	x <sup>b, c</sup>
Stomach	xx <sup>b</sup>	xx <sup>c</sup>	xx <sup>c</sup>
Pancreas		x <sup>b, c</sup>	
Bladder		x <sup>b</sup>	
Colon	xx <sup>b</sup>	x <sup>c</sup>	x <sup>c</sup>
Rectum	x <sup>b</sup>	x <sup>c</sup>	x <sup>c</sup>
Liver		x <sup>c</sup>	
Kidney	x <sup>b</sup>		
Ovary			x <sup>c</sup>
Uterine mucous membrane			x <sup>c</sup>
<b>Type 2 diabetes</b>	- <sup>a</sup>		
<b>Obesity</b>	x <sup>a, 1</sup>		

\* The extent of the protective effect is expressed according to the WHO's assessment system of evidence grades: xxx = convincing, xx = probable x = possible - = no correlation (see Table 2)

<sup>a</sup> Boeing et al. 2007, <sup>b</sup> DGE 2008, <sup>c</sup> WCRF, AICR 2007

<sup>1</sup> Prevention of body-weight gain

disease, hypertension and stroke. The protective effect is less clear in the case of cancer, however. Depending on the type of cancer, the evidence grade varies between possible and probable. There is currently not enough evidence to prove that increased fruit and vegetable consumption reduces the risk of type 2 diabetes mellitus. However, since obesity – one of diabetes' most important risk factors – can possibly be reduced if fruit and vegetables constitute a high proportion of a person's diet, an indirect lowering of incidence is conceivable (Boeing et al 2007; DGE 2008; WCRF, AICR 2007; WHO, FAO 2003).

**Table 2**  
Evidence grades according to the World Health Organization's assessment scheme (from WHO, FAO, 2003)

Evidence grade	Explanation
convincing	A considerable number of randomized controlled trials or prospective observational studies of appropriate quality show a consistent association between exposure and disease. There are few, if any, studies showing contrary associations. The association should be biologically plausible.
probable	Epidemiological studies show a predominantly consistent association between exposure and disease. However, there are deficiencies in the evidence, or some studies show contrary associations. The association should be biologically plausible.
possible	For the most part, the only associations are from case-control studies and cross-sectional studies. There is insufficient data from randomized controlled trials or cohort studies.
insufficient	The evidence is based on findings of a few studies which are insufficient to establish an association between exposure and disease. There is limited or no evidence available from randomized controlled trials.

### Upward trend in fruit and vegetable consumption over the last few decades

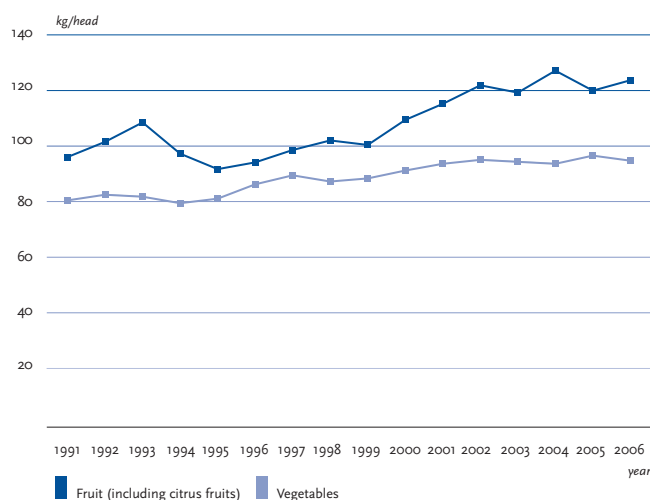
Data are collected every year for agricultural statistics on the per-capita amounts of food that are available for consumption in the German economy as a whole. This makes it possible to map longer-term trends in food consumption. There has been an upward development in the available amount of fruit and vegetables in recent years (Figure 1), annual per-capita fruit consumption being higher overall than the figure for vegetables (DGE 2008).

Fruit and vegetable consumption has also tended to rise at the European level over the last few decades. However, according to the figures for 2007 consumption of both fruit and vegetables in Germany is below the European average (OECD 2010).

### Recommendations on daily fruit and vegetable consumption

»OptimiX«, the optimized mixed diet of the Research Institute of Child Nutrition (Forschungsinstitut für Kinderernährung, FKE) recommends that children and adolescents between the ages of 6 and 17 each consume between 200g and 350g of fruit and vegetables a day, depending on age

**Figure 1**  
Usage of fruit (including citrus fruits) and vegetables 1991-2006  
Source: adapted from DGE 2008



and gender (FKE 2005). The German Society for Nutrition (DGE) currently recommends adults aged 18 and over, to eat at least 400g of vegetables and 250g of fruit a day (DGE 2010) (Table 3).

The two recommendations are reflected in the »5 a day« health-promotion campaign, which says that the recommended total intake amounts should, wherever possible, be taken as three portions of vegetables and two portions of fruit per person per day. A portion here is quantified as one handful of plant food, so that the amount consumed is adjusted to the respective constitution and thus to the specific needs of the consumer (5 am Tag e.V. 2010).

One portion of fruit or vegetables can be replaced by certain smoothies or one glass of fruit or vegetable juice (with a fruit or vegetable content of 100%). There are several reasons for the restriction to one glass of juice a day. First, the amount of valuable nutrients of the original product may be reduced by processing. Furthermore, juices have a

similar or even higher sugar and energy content to that of lemonades, without generating a satiety effect comparable to fresh fruit or vegetables. In this context, it is therefore recommended that juices be diluted with water wherever possible.

### Most children and young people don't reach the dietary recommendations

EsKiMo – the »Nutrition Study as KiGGS Module« – was conducted from January to December 2006 as part of the National Health Interview and Examination Survey for Children and Adolescents (KiGGS). It studied the diets of 2,506 girls and boys aged between 6 and 17 which were representative for Germany. For the age group aged between 6 and 11, the parents kept a dietary record for three days together with their child. A detailed standardized dietary history interview was conducted among the 12- to 17-year-olds using a survey instrument called DISHES (Mensink et al 2007).

The result was that, among the 6- to 11-year-olds, 19% of the girls and 15% of the boys reached the age-specific »OptimiX« recommendation on fruit consumption; among the 12- to 17-year-olds the corresponding figures were 25% for the girls and 16% for the boys. The age-specific vegetable recommendation was reached by only 7% of the girls and 6% of the boys in the 6-to-11-year-old group, and by 29% of the girls and 18% of the boys in the 12- to 17-year-old group (Table 4).

Looking at overall fruit and vegetable consumption and adding up to a glass of fruit or vegetable juice, the result is that 33% of the girls and 27% of the boys aged between 6 and 11 reached the age-specific recommendation for fruit and vegetable consumption. The figures for the 12- to 17-year-olds were as high as 47% for the girls and 29% for the boys. Even so, the quantity of daily fruit and vegetable consumption is not yet optimal.

**Table 3**  
Recommended fruit and vegetable intake per day, by age and sex  
Source: FKE 2005, DGE 2010

Age	Sex	Recommendation	
		Fruit in grams	Vegetables in grams
<b>Children</b>			
6 years	both	200	200
7–9 years	both	220	220
10–12 years	both	250	250
<b>Adolescents</b>			
13–14 years	girls	260	260
	boys	300	300
15–17 years	girls	300	300
	boys	350	350
<b>Adults</b>			
18 years +	both	250	400

**Table 4**  
Percentage of children and adolescents who consume the recommended daily amounts of fruit and vegetables  
Data basis: EsKiMo 2006

	Empfehlung erreicht		
	Fruit	Vegetable	Fruit and Vegetable*
<b>Girls</b>			
6–11 years	18.8%	7.4%	33.0%
12–17 years	25.3%	29.4%	47.3%
<b>Boys</b>			
6–11 years	15.1%	5.5%	26.5%
12–17 years	15.6%	18.2%	28.9%

\* Including up to one glass of fruit or vegetable juice

## Fewer than 10% of adults consume five portions of fruit and vegetables a day

The 2009 »German Health Update« study (GEDA 2011) provides topical figures on the consumption of fruit and vegetables. Unlike in the EsKiMo study, the participants were asked how frequently they consumed the portions of fruits, vegetables and juice; they were not questioned about detailed amounts in grams: 12% of 18- to 90-year-old women and 6% of men in the same age group consumed the recommended five portions of fruit and vegetables a day. All the same, 43% of the women and 26% of the men ate at least three portions of plant-based foods daily. Although the proportion of people who reached the recommended five portions a day showed no clear age trend, the percentage of men who consumed at least three portions of fruit and vegetables a day rose significantly from the age of 50. The age profile among women was less consistent, but here, too, more older than younger women consumed at least three portions of fruit and vegetables a day (Figure 2).

## On average women consume more portions of fruit and vegetables

According to self-reported data from the 2009 GEDA study, 18- to 50-year-old men consumed an average of about two portions of fruit and vegetables a day when up to one glass of juice was included. Women ate more portions of fruit and vegetables than men of the same age on average. The 20- to 50-year-old women consumed 2.6 portions of fruit and vegetables a day; women in the older age groups ate nearly three portions (Figure 3).

## German Health Update (GEDA)

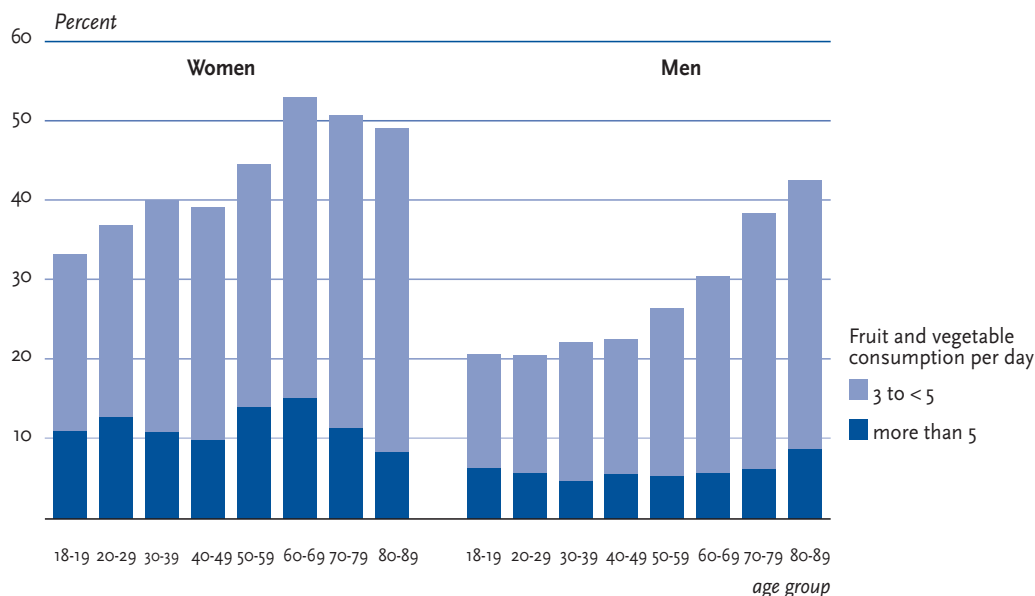
<i>Data holder:</i>	Robert Koch Institute
<i>Objectives:</i>	To provide up-to-date data on health-related issues, to analyse temporal developments and trends
<i>Survey method:</i>	Computer-assisted telephone interviews (CATI)
<i>Population:</i>	Residential population of Germany aged 18 and over
<i>Sample:</i>	21,262 women und men
<i>Cooperation rate:</i>	51.2%
<i>Survey period:</i>	July 2008 to June 2009

## Consumption of fruit and vegetables varies according to social characteristics

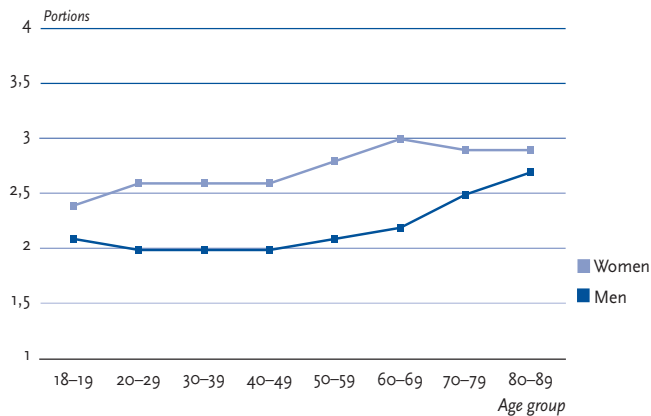
Numerous studies indicate a correlation between fruit and vegetable consumption and various socio-demographic determinants (Buijsse et al. 2009; Giskes et al. 2002; De Irala-Estevez et al. 2000). The 2009 GEDA study also found such relationships: as the level of education rose, there was a recognizable increase in the proportion of people of both sexes who consumed at least three or at least five portions of fruit and vegetables a day (Figure 4). A similar increase in the frequency of consumption was observed among people as incomes rose, among people who were frequently active in sports, and among non-smokers as opposed to current smokers.

It is striking that the proportion of ex-smokers who consume more than five portions of fruit and vegetables a day was almost the same as that of non-smokers in men; in women it was actually higher than among non-smokers (Table 5).

**Figure 2**  
Percentage of people who eat at least three or at least five portions of fruit and vegetables per day, by age and sex  
Data basis: GEDA 2009



**Figure 3**  
Mean number of portions of fruit and vegetables per day, by age and sex  
Data basis: GEDA 2009

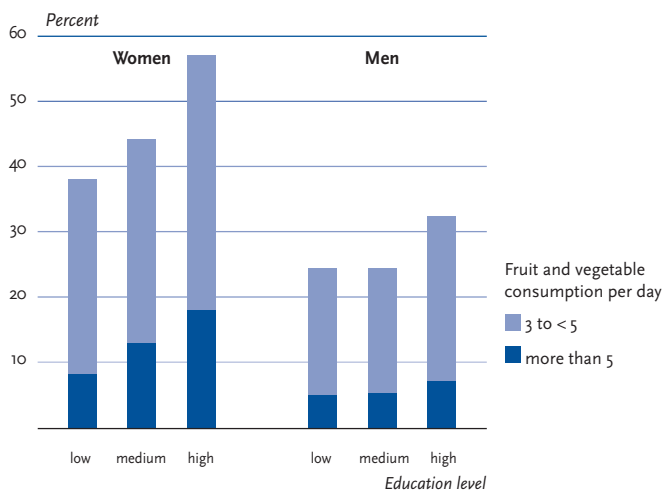


### The higher the daily fruit and vegetable consumption, the higher was the relative contribution of the fruit portions

According to the dietary recommendations of the German Society for Nutrition, people should consume at least three portions of vegetables, two portions of fruit, including optionally up to one glass of fruit or vegetable juice a day.

The actual ratios of consumed portions of fruit, vegetables and juice for different groups in the 2009 GEDA study are shown in Figure 5. The number of daily portions of fruit consumed increased continuously up to the group that consumed less than five servings of fruit and vegetables a day. The relative proportion of fruit portions also seemed to increase with the people's age (not shown). This suggests that people frequently succeeded in approaching the recommendation by consuming a relatively large amount of fruit, although the proportion of vegetables should be larger according to the recommendation.

**Figure 4**  
Percentage of consumers who eat at least three or at least five portions of fruit and vegetables per day, by education level and sex  
Data basis: GEDA 2009



**Table 5**  
Fruit and vegetable consumption by income, sport and smoking status  
Data basis: GEDA 2009

	Women			Men		
	Portions per day			Portions per day		
	0- < 3	3- < 5	5+	0- < 3	3- < 5	5+
<b>Total</b>	56.6%	31.5%	11.9%	74.1%	20.3%	5.6%
<b>Income*</b>						
<20%	59.0%	31.5%	9.5%	76.6%	17.7%	5.8%
20-80%	56.8%	31.4%	11.8%	74.3%	20.8%	5.0%
>80%	52.8%	31.8%	15.3%	72.1%	20.9%	7.0%
<b>Sport per week</b>						
0 hours	64.4%	28.4%	7.3%	77.0%	18.7%	4.4%
<2 hours	57.8%	31.7%	10.5%	76.4%	19.8%	3.8%
2-4 hours	51.6%	33.9%	14.6%	72.8%	21.1%	6.1%
>4 hours	47.0%	34.1%	18.9%	70.1%	22.0%	8.0%
<b>Smoking status</b>						
Smokers	69.1%	23.4%	7.5%	80.6%	14.5%	4.9%
Non-smokers	51.7%	35.2%	13.2%	70.1%	23.8%	6.1%
Ex-smokers	53.3%	32.3%	14.4%	71.6%	22.6%	5.8%

\*Groups based on the net equivalent income. The net equivalent income is defined as a household's net income after it has been 'demand-weighted' according to the household's size and composition. This takes into account the savings made by joint economies in a multi-person household and the different income demand of adults and children. The groups were categorized according to the population distribution of the net equivalent income (bottom 20%, 20-80%, upper 20%).

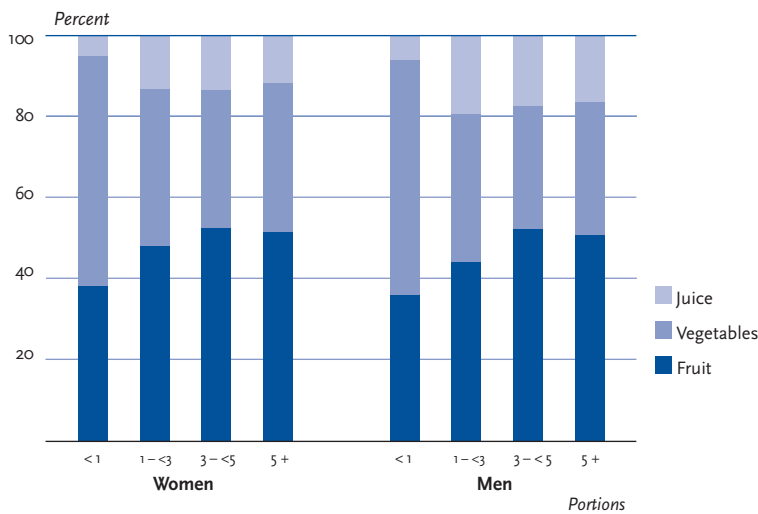
### Discussion

A high level of fruit and vegetable consumption is an important factor in the prevention of several chronic diseases. For this reason, the German Society for Nutrition has issued age-specific dietary recommendations for children, adolescents and adults; for the sake of clarity these are simplified in educational announcements on nutrition to »five portions of fruit and vegetables a day«.

Available studies suggest that these consumption recommendations are only reached by a small proportion of people in Germany: of the adults surveyed in the GEDA 2009 study, 12% of women and 6% of men consumed the desired portions of fruit and vegetables per day. Larger percentages of the 18- to 80-year-old women and men reached the respective recommendations according to the National Nutrition Survey II (NVS II), another nutrition survey representative of Germany which was conducted by the Max Rubner Institute in 2005-2006. According to this study, 15% of women and 12% of men ate vegetables – and 63% of women and 51% of men ate fruit – in line with the DGE recommendations (MRI 2008).

To some extent, the differences in the percentages between GEDA 2009 and the NVS II are probably due to methodological aspects. In the GEDA study, questions on portion frequency were based on a standardized computer-assisted telephone interview, whereas NVS II collected its data on fruit and vegetable consumption based on detailed quantities measured in grams in the course of an extensive interview using a special software programme (DISHES).

**Figure 5**  
**Proportions of fruit, vegetable and juice portions by consumption and sex**  
 Data basis: GEDA 2009



It should also be borne in mind that the recommendation on portions cannot be equated one-to-one with the quantity-based recommendations, since the gram quantities for normal portions can vary depending on the type of fruit or vegetable (5 am Tag e.V. 2010).

In addition, the NVS II has not published any results on combined fruit and vegetable consumption to date. These figures would probably be lower than the separate ones for fruit and vegetables. At least, this seems likely based on an evaluation of the GEDA data on the separate consumption of fruit and vegetables. According to this, 48 % of the women and 31 % of the men consumed at least two portions of fruit, but only 9 % of the women and 5 % of the men consumed at least three portions of vegetables a day – in each case adding up to one glass of fruit or vegetable juice. In this calculation the figures are closer to those of the NVS II.

Although the recommendations on the daily intake of fruit and vegetables are rarely reached by adults, it was observed in GEDA 2009 that a significant percentage of the population aged 18 years and over did consume three portions of fruit and vegetables on average per day. According to EsKiMo data, 33 % of 6- to 11-year-old girls and 27 % of boys in the same age group reached the recommendations on fruit and vegetable consumption. Among the 12- to 17-year-olds the figures were 47 % for girls and 29 % for boys.

Hence, the amounts of fruit and vegetables consumed on a daily basis are not yet optimal. This has also been confirmed by the Dortmund Nutritional and Anthropometrical Longitudinally Designed study (DONALD), which covers food intake by infants, children and adolescents aged between 0 and 18 in the Dortmund area. The results on fruit and vegetable consumption in the period between 1998 and 2002 are largely in line with

the observations made by EsKiMo. The vegetable intake figures in the DONALD study are also well below 50 % of the recommended amounts in all age groups. The fruit intake levels are only reached on average by including up to one glass of fruit juice and are about as low as in the EsKiMo study (Kersting et al 2004).

An overall consideration of the population's consumption of fruit and vegetables shows that girls and women are more likely to eat the recommended daily amounts than boys and men. It is striking in this context, however, that the average number of portions consumed by men over 50 interviewed in the GEDA study gradually but continuously increased. Both in GEDA and in the NVS II, men in the oldest age group respectively were found to eat the most fruit and vegetables. In addition to age issues, GEDA 2009 also revealed correlations with other socio-demographic characteristics. For example, a higher level of fruit and vegetable consumption was observed with increasing levels of education, rising incomes, more frequent exercise, and among non-smokers.

It can be assumed that campaigns propagating a frequent daily consumption of fruit and vegetables have contributed to increasing fruit and vegetable consumption in the German population. However, further efforts to raise consumption are needed. These include improving the availability of fruit and vegetables in everyday life and in various areas of life – such as kindergartens, schools or the workplace. It is important in this context to emphasize compliance with food-hygiene measures. People should therefore be encouraged to eat only fruit and vegetables that have been thoroughly washed in water to remove as many germs and toxins such as pesticides or preservatives from the surface of plant-based foods.

It should always be borne in mind that health-conscious behaviour involves more than compliance with the daily

fruit and vegetables recommendations. Because chronic diseases have multifactorial causes, people should not only increase their fruit and vegetable consumption, but also ensure that they have a balanced diet and a physically active lifestyle, and avoid risk factors like obesity and smoking.

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