

# Fruit and Vegetable Intake in a Sample of 11-Year-Old Children in 9 European Countries: The Pro Children Cross-Sectional Survey

Agneta Yngve<sup>a</sup> Alexandra Wolf<sup>fb</sup> Eric Poortvliet<sup>a</sup> Ibrahim Elmadfa<sup>b</sup>  
Johannes Brug<sup>c</sup> Bettina Ehrenblad<sup>a</sup> Bela Franchini<sup>d</sup>  
Jóhanna Haraldsdóttir<sup>e</sup> Rikke Krølner<sup>f</sup> Lea Maes<sup>g</sup> Carmen Pérez-Rodrigo<sup>h</sup>  
Michael Sjöström<sup>a</sup> Inga Thórsdóttir<sup>i,j</sup> Knut-Inge Klepp<sup>k</sup>

<sup>a</sup>Department of Biosciences, Unit for Preventive Nutrition, Karolinska Institutet, Stockholm, Sweden;

<sup>b</sup>Institute for Nutritional Sciences, University of Vienna, Vienna, Austria; <sup>c</sup>Department of Public Health, Erasmus University Medical Center Rotterdam, Rotterdam, The Netherlands; <sup>d</sup>Faculty of Nutrition and Food Sciences, University of Porto, Porto, Portugal; <sup>e</sup>Research Department of Human Nutrition, Royal Veterinary and Agricultural University, and <sup>f</sup>Department of Social Medicine, Institute of Public Health, Faculty of Health Sciences, University of Copenhagen, Copenhagen, Denmark; <sup>g</sup>Department of Public Health, Ghent University, Ghent, Belgium; <sup>h</sup>Community Nutrition Unit, Bilbao, Spain; <sup>i</sup>Unit for Nutrition Research, Landspítali University Hospital, and <sup>j</sup>Department of Food Science, University of Iceland, Reykjavik, Iceland; <sup>k</sup>Department of Nutrition, Faculty of Medicine, University of Oslo, Oslo, Norway

## Key Words

European schoolchildren · Fruit intake · Vegetable intake · 24-Hour recall · Food frequency · Pro Children study

## Abstract

**Background/Aims:** An adequate fruit and vegetable intake provides essential nutrients and nutritive compounds and is considered an important part of a healthy lifestyle. No simple instrument has been available for the assessment of fruit and vegetable intake as well as its determinants in school-aged children applicable in different European countries. Within the Pro Children Project, such an instrument has been developed. This paper describes the cross-sectional survey in 11-year-olds in 9 countries. **Methods:** The cross-sectional survey used nationally, and in 2 countries regionally, representative samples of schools and classes. The questionnaires, including a precoded 24-hour recall component and a food frequency part, were completed in the classroom. Data

were treated using common syntax files for portion sizes and for merging of vegetable types into four subgroups. **Results:** The results show that the fruit and vegetable intake in amounts and choice were highly diverse in the 9 participating countries. Vegetable intake was in general lower than fruit intake, boys consumed less fruit and vegetables than girls did. The highest total intake according to the 24-hour recall was found in Austria and Portugal, the lowest in Spain and Iceland. **Conclusion:** The fruit and vegetable intake in 11-year-old children was in all countries far from reaching population goals and food-based dietary guidelines on national and international levels.

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## Introduction

For promotion of eating habits which are in line with recent food-based dietary guidelines [1–4], it is important to have valid and reliable, simple assessment tools avail-

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Agneta Yngve  
Unit for Preventive Nutrition, Department of Biosciences, Novum  
SE-141 57 Huddinge (Sweden)  
Tel. +46 8 608 9209, +46 70 550 6557 (mobile), Fax +46 8 608 3350  
E-Mail [agneta.yngve@prevnut.ki.se](mailto:agneta.yngve@prevnut.ki.se)

**Table 1.** WHO population goal<sup>1</sup> and national food-based dietary guidelines for fruit and vegetable intake

Country	Recommendation			Comments
	fruit	vegetables	total	
WHO Europe			≥ 400g	tubers excluded; all age groups included
Austria	250 g	250 g	5 times/day	potatoes excluded; for 10- to 12-year-olds
Belgium	1–3 portions	300 g		juice and potatoes excluded; from 6 years and onwards
Denmark	3 portions	3 portions	600 g	potatoes excluded, juice included as maximum one portion; for children from 10 years and above and adults; portions used for evaluation of intake
Iceland	>200 g	>200 g	500 g	potatoes excluded, fruit juice included in total; all age groups
Netherlands	2 pieces of fruit	150 g		potatoes excluded; one piece of fruit can be taken as juice; a piece equals approx. 125 g of fruit, or one apple
Norway	2 portions	3 portions	750 g	potatoes and fruit juice included; for adults; same number of portions for children although smaller
Portugal	3–5 portions	3–5 portions		potatoes excluded; portions used for evaluation of energy/calories intake: 3–5 portions for 2,200 kcal – general population; 5 for >3,000 kcal
Spain	3 portions	2 portions	≥ 400 g	potatoes and fruit juice excluded; same number of portions for children although smaller; portions used for evaluation of intake
Sweden			≥ 400–500 g	potatoes excluded, fruit juice counted as maximum 100 g; 400 g for children up to 10; 500 for all >10 years of age

<sup>1</sup> Population intake goals represent the population average intake that is judged to be consistent with the maintenance of health in a population.

able. No such assessment tool exists in Europe for use in cross-national comparisons. During the last decades, an increasing amount of attention has been paid to the importance of a high fruit and vegetable intake as an essential part of a healthy lifestyle [1, 2]. The importance of fruit and vegetables for providing essential nutrients such as folate, vitamin C and  $\beta$ -carotene has been emphasized by several reports [1–5], as well as for providing antioxidants of nonvitamin nature and so-called phytoestrogens [1–5]. A number of international recommendations [1, 3, 4] and population targets [2] have been published regarding the desirable level of consumption of fruit and vegetables for adults. A summary of the range reported in the national food-based dietary guidelines for fruit and vegetable intake in the European region is ‘more than 400–600 g per day’ [6], where the range stands for the variability between countries. The WHO population goal [3] for fruit and vegetable intake is 400 g per day. National food-based dietary guidelines for adults can be found in all investigated countries [3, 7–15], specific guidelines for children exist in

some of the investigated countries [3, 7, 10–13, 15–17] (table 1). The guidelines in some cases include suggestions for how they can be used to evaluate intakes.

Fruit and vegetable intake of children has not been extensively monitored on the European level, but has been studied in some national [18–20] surveys. There have been attempts to quantify the intake of individual members of the household from household budget surveys [21], thereby providing possibilities for identifying the fruit and vegetable intake of children. The Health Behaviour in School-Aged Children Study [22] has collected data on fruit and vegetable intake through a simple food frequency questionnaire since 1985. A common protocol for a slightly more sophisticated method of investigating the fruit and vegetable intake in schoolchildren has been missing in the European context.

#### *The Pro Children Project*

The Pro Children cross-sectional survey was designed to provide information on actual levels of fruit and veg-

**Table 2.** Sample selection, response rates, dropout and data cleaning description by country

Country	Partici- pants	Response rate		Dropout rate		Data entry		Data included in the analyses		
		n	% of part	n	% of part	n	% of part	n	% of part	% of data entry
Norway	1,347	1,205	89.5	9	0.7	1,196	88.8	1,157	85.9	96.7
Spain	1,410	1,335	94.7	22	1.6	1,313	93.1	1,289	91.4	98.2
Iceland	1,392	1,235	88.7	39	2.8	1,196	85.9	1,176	84.5	98.3
Denmark	2,111	1,942	92.0	23	1.1	1,919	90.9	1,859	88.1	96.9
Portugal	2,535	2,494	98.4	360	14.2	2,134	84.2	2,118	83.6	99.3
Austria	1,857	1,769	95.3	77	4.1	1,692	91.1	1,656	89.1	97.9
Netherlands	1,396	1,113	79.7	8	0.6	1,105	79.2	1,096	78.5	99.2
Sweden	1,752	1,476	84.2	69	3.9	1,407	80.3	1,364	77.9	96.9
Belgium	1,604	1,355	84.5	12	0.7	1,343	83.7	1,322	82.4	98.4
Total	15,404	13,924	90.4	619	4.0	13,305	86.4	13,037	84.6	98.0

part = Participants.

etable intake among European schoolchildren and their parents as well as the determinants of such consumption patterns. The Pro Children cross-sectional survey constitutes the first ever cross-national comparison of fruit and vegetable intake performed in children, while including determinants (cultural, socioeconomic, and sociocognitive factors). The large variation seen in eating habits across Europe, including practices related to the fruit and vegetable intake, made it particularly important to conduct such a study.

The main objective of the present paper was to describe the results of the Pro Children cross-sectional survey with regard to the total fruit and vegetable intake and frequency of consumption in children in all the participating countries, compared to relevant dietary guidelines.

## Method

The cross-sectional survey of the schoolchildren and their parents was conducted in all 9 countries during October to December 2003. Schools constituted the sampling unit, and from each country samples of at least 20 schools and a minimum of 1,300 eligible children were included. The student sample size was seen as sufficient to allow for the planned within-country comparisons (gender, socioeconomic status and urban-rural differences) and take the school component of the variance into account. The target group was children born in 1992. Nationally statistically representative samples of schools were drawn in each country with the exception of Austria and Belgium. For Austria, the sample is statistically representative of the eastern region (population of approximately 4 million; 42% of total population). For Belgium, the sample is statistically representative of Flanders (the Dutch-speaking north-western half of the

country, population of approximately 6 million, 58% of total population). The response rates, dropouts and incomplete questionnaires rejected during data cleaning are described in table 2, while the age and gender distribution of the final sample is described in table 3. Only 1.7% of the 24-hour recall (0.6 girls/1.1 boys) and 1.9% of the food frequency (0.9 girls/1.0 boys) questionnaires were excluded from the analysis due to incomplete answers in the dietary intake part of the questionnaire.

### *The Instrument*

A comprehensive survey instrument assessing fruit and vegetable intake and psychosocial factors associated with these consumption patterns was developed for both pupils and their parents. The instruments were originally developed in English prior to translation into the relevant languages within each participating country. These national versions were then back-translated into English by language-proficient individuals not involved in the development of the instruments.

The dietary questionnaire comprises two sections: a precoded 24-hour recall component asking in detail about yesterday's fruit and vegetable intake, and a food frequency part with 5 questions on usual fruit and vegetable intake. The 24-hour recall component was used for measuring group mean intake and for specifying the type of fruits and vegetables eaten, whereas the food frequency part was used for ranking subjects according to their usual intake. The instrument is further described by Haraldsdottir et al. [23]. Multiple pilot tests, including reliability and validity testing, were conducted in a number of countries before the final instrument was decided upon [23]. Based on formal testing of the child instruments in Belgium, Denmark, Iceland, Norway and Portugal, it was concluded that the questionnaire instrument was valid and reliable in giving national group means of fruit and vegetable intake among 11-year-old children as well as ranking them by intake.

### *The Procedure*

The headmasters of the schools were approached about their willingness to participate, and the class teachers were asked to col-

**Table 3.** Age and gender distribution of the final sample by country and total

Country	Total			Girls			Boys			% boys
	n	age	SD	n	age	SD	n	age	SD	
Austria	1,656	11.0	0.59	871	11.0	0.59	785	11.1	0.60	47.4
Belgium	1,322	11.5	0.46	606	11.5	0.46	716	11.5	0.46	54.2
Denmark	1,859	11.4	0.38	918	11.3	0.35	941	11.4	0.39	50.6
Iceland	1,176	11.3	0.33	562	11.3	0.34	614	11.3	0.31	52.2
Netherlands	1,096	11.7	0.46	590	11.7	0.44	506	11.8	0.48	46.2
Norway	1,157	11.3	0.32	569	11.3	0.32	588	11.3	0.31	50.8
Portugal	2,118	11.5	0.45	1,115	11.5	0.43	1,003	11.5	0.47	47.4
Spain	1,289	11.4	0.44	599	11.4	0.41	690	11.4	0.46	53.5
Sweden	1,364	11.4	0.47	687	11.4	0.47	677	11.4	0.46	49.6
Total	13,037	11.4	0.48	6,517	11.3	0.47	6,520	11.4	0.48	50.0

lect the data using standardized instructions. The data for the children's intake were collected directly in the classroom using the validated instrument. Data were entered at the national centers, according to a standardized protocol, prior to submission to the joint Data Management Centre at the University of Vienna, where data processing and quality control has taken place.

#### Data Treatment

The results from the 24-hour recalls regarding vegetables were merged into four subgroups, i.e. salad, raw vegetables, cooked vegetables and soup vegetables, in order to provide useful information for the design of interventions. The results from the food frequency questionnaire were converted to 'once a day or more' regarding frequency of total fruit and vegetable intake. Portion sizes were corrected for differences in standard servings between countries, in particular for cucumber and carrots (due to different slicing habits for pieces or slices). A maximum number of portions consumed per meal was determined for each fruit and vegetable item and intakes were adjusted using a standardized script. The results were tested for age-related differences. As no such differences could be identified, the results are presented only according to gender and country.

#### Research Clearance

The cross-sectional survey involves children (9–13 years of age) and their parents (healthy volunteers). Self-administered questionnaires are the only research instruments used. Parental written consent was obtained prior to including the children in the cross-sectional survey. Furthermore, research clearance was obtained from research ethics committees in all countries where this was regulated for this kind of noninvasive study.

#### Data Analysis

Data analysis was conducted using the program software Statistical Package for Social Sciences 12.0 (SPSS). For age and gender differences, statistical significance was established as  $p < 0.05$ . Non-parametric Mann-Whitney U tests corrected with Shaffer were used, due to the absence of normal distribution of consumption data even after logarithmic transformation.

## Results

### 24-Hour Recall

Fruit, fruit juice, vegetable, as well as added fruit and vegetable intake are presented in table 4a–d. Girls had a significantly higher fruit, vegetable and total fruit and vegetable intake than boys ( $p < 0.000$ ) and a slightly higher fruit juice intake, though not significant ( $p = 0.098$ ). A large variation in consumption was found between the countries. The highest overall fruit intakes were found in Austria, Denmark and Portugal (171, 157 and 153 g). Fruit intakes were lowest in Iceland and Spain (90 and 118 g). Children in Portugal, Sweden and Belgium showed the highest overall vegetable intakes in this study (mean 111, 109 and 105 g). The countries with the lowest vegetable intakes were Iceland and Spain (mean 54 and 58 g). The highest overall fruit and vegetable intakes were found in Austria and Portugal (265 and 264 g), while the lowest intakes were found in Iceland and Spain (143 and 176 g). The highest juice intakes were found in Austria and the Netherlands (360 and 267 g), the lowest in Portugal and Denmark (142 and 143 g).

Figure 1 presents the average fruit intake in grams per day per country. Figure 2 shows vegetable intake in grams/day per country indicating the type of vegetables eaten. Raw vegetables were consumed much more in the northern countries. In Portugal and Spain, the main intake of vegetables came from vegetable soup.

### Food Frequency Questionnaire

The food frequency data are presented in figures 3 and 4. The percentage of children choosing the alternatives

**Table 4.** The 24-hour recall (P = percentile)**a** Fruit intake (g)

Country	Total						Girls		Boys	
	mean	95% CI	median	P25	P75	P90	mean	median	mean	median
Austria	171	163–179	150	0	250	400	171	125	171	150
Belgium	137	130–145	100	0	200	300	142	100	133	100
Denmark	157	150–164	100	0	200	400	168	150	146	100
Iceland	90	83–96	50	0	100	250	87	50	93	50
Netherlands	134	126–142	100	0	200	300	142	100	125	100
Norway	149	140–158	100	0	200	375	157	100	141	100
Portugal	153	147–158	150	50	200	300	152	150	153	125
Spain	118	111–125	100	0	200	300	117	100	118	100
Sweden	129	122–136	100	0	200	300	134	100	125	100
Total	141	138–143	100	0	200	300	144	100	137	100

**b** Juice intake (g)

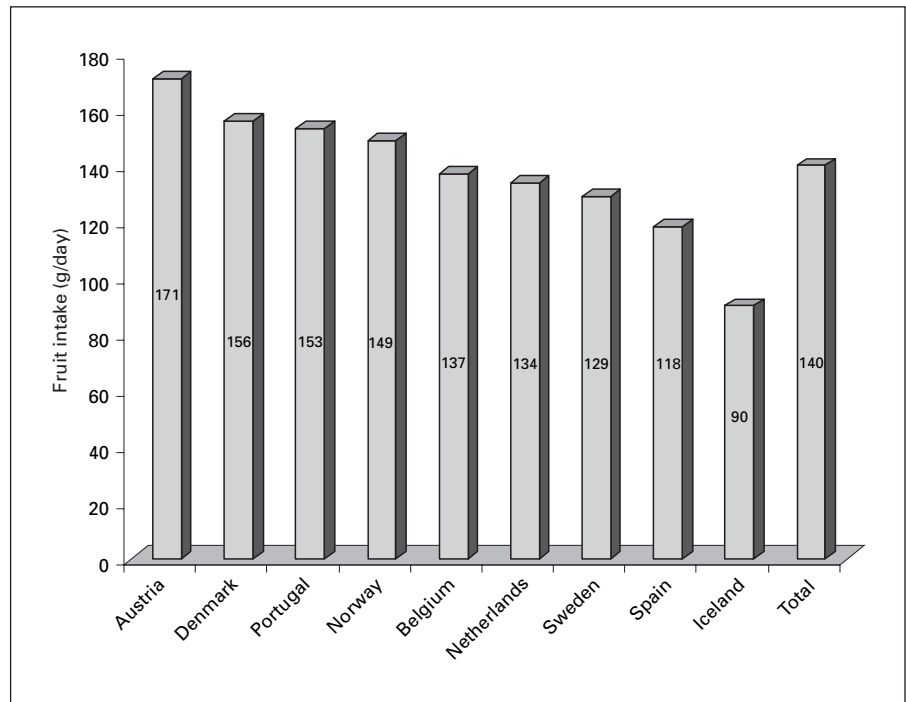
Austria	360	343–378	300	0	600	800	348	300	375	400
Belgium	225	210–240	200	0	400	600	215	200	234	200
Denmark	143	133–154	0	0	200	400	144	0	142	0
Iceland	211	197–225	200	0	400	600	200	200	221	200
Netherlands	267	250–284	200	0	400	600	287	200	244	200
Norway	195	179–211	0	0	400	600	207	100	184	0
Portugal	142	133–150	0	0	200	400	135	0	150	0
Spain	213	202–225	200	0	400	500	212	200	214	200
Sweden	197	182–212	0	0	400	600	186	0	209	0
Total	213	208–217	200	0	400	600	209	200	215	200

**c** Vegetable intake (g)

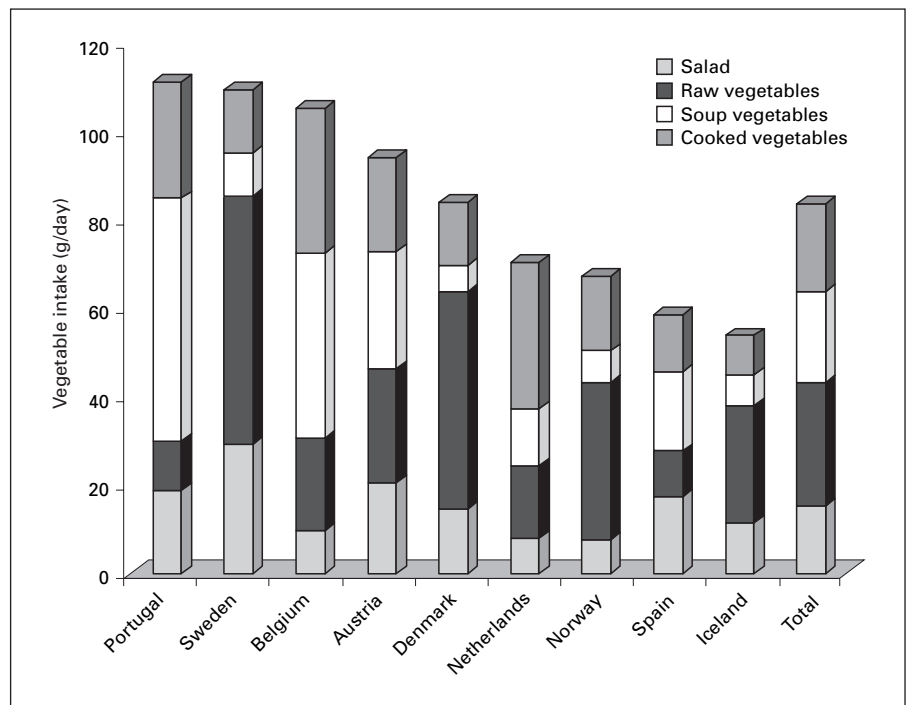
Austria	94	89–99	60	0	140	240	99	60	88	60
Belgium	105	100–110	80	30	150	235	101	80	108	80
Denmark	84	79–89	40	0	125	231	92	60	76	40
Iceland	54	49–59	10	0	70	165	57	30	50	0
Netherlands	70	65–75	60	0	100	160	73	60	67	60
Norway	67	62–73	30	0	105	195	75	40	60	10
Portugal	111	107–115	80	30	160	250	112	90	110	80
Spain	58	54–62	40	0	80	160	56	40	60	40
Sweden	109	103–115	75	20	155	265	118	80	100	65
Total	86	85–88	60	0	130	220	90	60	83	60

**d** Fruit plus vegetable intake (g)

Austria	265	254–275	210	100	390	590	269	220	259	200
Belgium	242	232–252	200	100	340	500	243	210	242	200
Denmark	241	231–250	200	80	350	535	260	215	222	180
Iceland	143	134–153	100	0	200	350	144	100	143	100
Netherlands	204	194–214	165	100	284	430	214	180	193	160
Norway	216	204–228	160	60	315	505	232	200	201	143
Portugal	264	256–271	240	130	361	500	264	240	263	240
Spain	176	168–185	145	50	250	390	174	150	179	140
Sweden	238	228–249	200	93	340	500	251	225	225	190
Total	227	224–230	190	80	330	500	235	200	219	180



**Fig. 1.** Mean consumption of fruit (g/day).



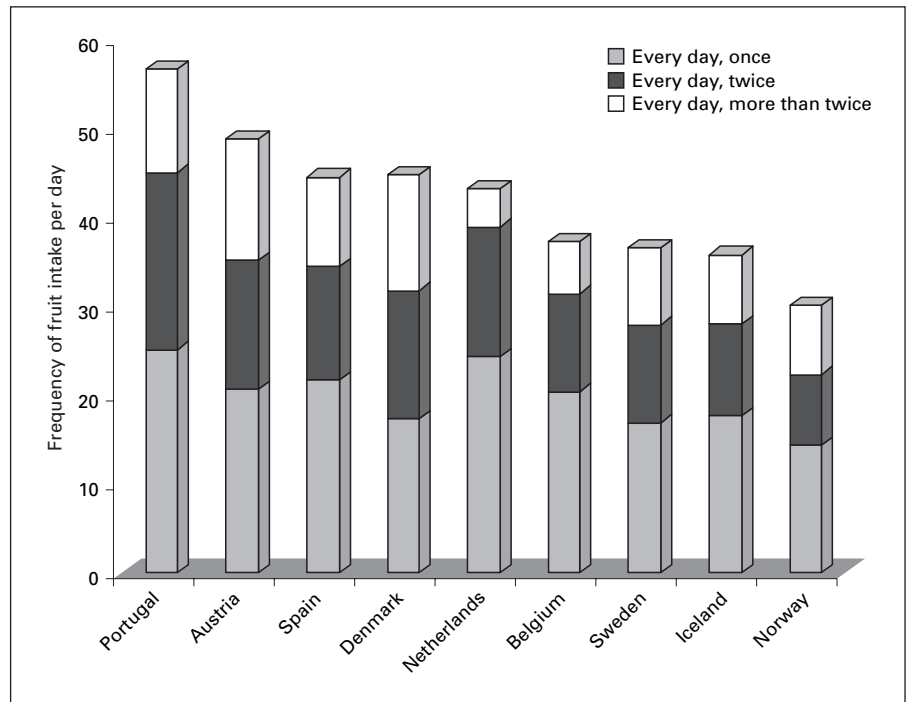
**Fig. 2.** Mean consumption of vegetables, shown as subgroups and total (g/day).

once every day, twice every day, more than twice every day for both fruit and vegetable is shown. Less than half of all the investigated children indicated that they eat fruit (48%) or vegetable (45%) every day.

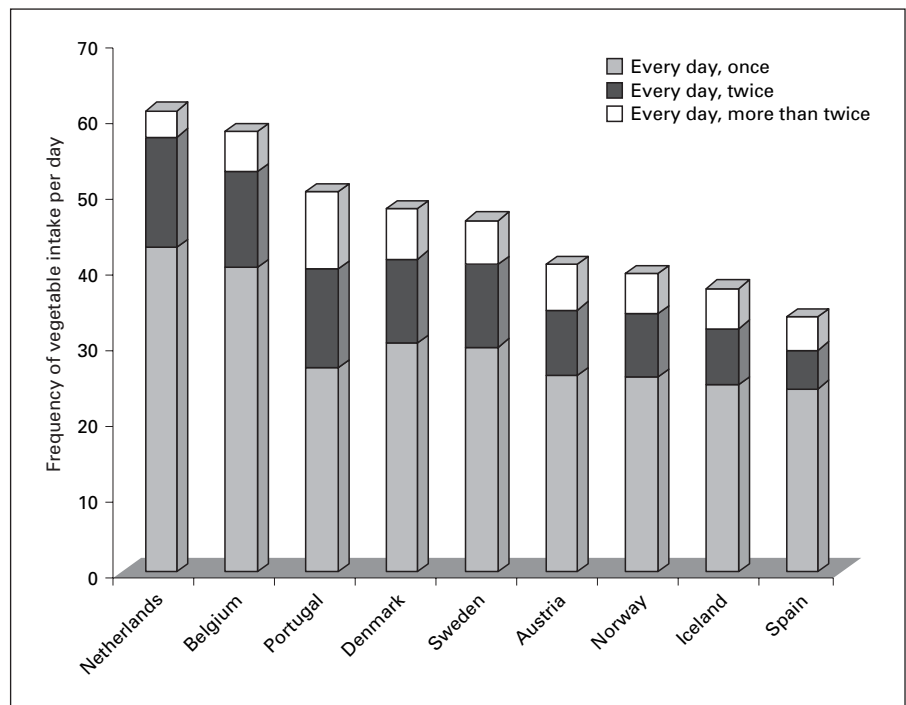
## Discussion

Among the 9 European countries participating in this cross-sectional survey, a diverse and complicated picture of fruit and vegetable intake emerged. Children in all





**Fig. 3.** Frequency of intake of fruit,  $\geq 1$  time per day.



**Fig. 4.** Frequency of intake of vegetables,  $\geq 1$  time per day.

countries showed relatively low intakes of both fruit and vegetables with consistently lower intakes of vegetables. Boys had in general a lower fruit and vegetable intake than girls. There was no clear north-south gradient, except for the type of vegetables eaten (raw vegetables,

cooked vegetables and vegetable soup). The higher intake of raw vegetables in the northern countries might reflect different preferences, but could also have been due to culturally dependent factors related to food preparation and availability.

The response rates were overall unusually high, probably due to the use of schools and classes as sampling units. Due to the school-based survey, respondent bias (overrepresentation of healthy, well-educated subjects) was probably lower than in other types of studies. Because of the statistically representative samples in all countries except for Belgium and Austria, the results should be representative for the countries, and for Belgium and Austria for the chosen regions. Comparisons between the countries could however present some problems, due to differences in food culture and perception of portion sizes.

The main limitation of the 24-hour recall in this pre-coded instrument was that intakes were recorded for one weekday only and therefore did not reflect usual intake. The food frequency questionnaire should to some extent have corrected for this and in comparison, the ranking of countries based on actual intake (24-hour recall) fits rather nicely with the ranking of usual intake (food frequency questionnaire). In Spain, we could, however, see that the ranking for usual intake seemed higher than the actual intake for fruit, and in the Netherlands the ranking for usual intake was higher for vegetables than the one for actual intake. Group averages of weekday intakes were considered relatively reliable due to the narrow age range and such large samples in each country.

Another problem with the instruments was the portion size estimation for carrots and cucumber that was performed by the Pro Children consortium, where the ways of serving these vegetables turned out to be diverse between countries (e.g. sticks of different sizes, thick or thin slices). Also, as was shown in focus groups [24], children in Belgium had problems distinguishing fruit juice from lemonades and other fruit-based drinks, which is why the data on fruit juice should be interpreted with caution.

Fruit juice intake seemed high in some countries, and may have contributed substantially to the intake of vitamin C and folate. Another problem with the survey results was the fact that different vegetables have very different contents of active compounds of nutrients and other potentially nutritionally important components.

In adding up intakes of different kinds of fruits and vegetables to total intake levels, we therefore neglected possibly relevant differences within the fruit and vegetable food groups. We did not include potatoes in the analysis, which might provide substantial amounts of vitamin C in countries where potato consumption is high. Another problem was the season when the data were collected. October and November are in many countries, except for Spain, the period when nationally

or locally grown fruit, berries and vegetables are available in vast amounts. This could mean that data for fruit and vegetable intake collected at other times of the year could be even lower, or in the case of Spain that fruit and vegetable intake would be higher if collected at another time of the year.

Generally, the results of the present study were in line with the results from earlier studies on fruit and vegetable intake in the participating countries [9, 19, 25–30] when taking the differences in methodology and year of survey into account. The results of the present study for both fruit and vegetable intake frequency also show roughly the same ranking of countries as the Health Behaviour in School-Aged Children Study [22]. However, data on availability of fruits and vegetables [31, 32] show a north-south gradient, where the southernmost countries had the highest availability; a finding that was not reflected in the present results.

The WHO population goal [3] for consumption of fruit and vegetables (table 1) is 400 g per day. It does not specify whether fruit juice should be included. The WHO population goal represents the population average that is judged to be consistent with the maintenance of health. No clear guidelines on how to interpret the population goal for intake evaluation purposes could be identified. Our analyses indicate that average intakes of children in almost all countries exceeded the population goal of 400 g when our data on fruit juice were included. However, we showed earlier [24] that children of this age had problems distinguishing fruit juice from other fruit drinks or lemonades. After exclusion of juice intake, the results showed that mean intakes of fruit and vegetables in all countries were lower than the WHO population goal. Children in Austria and Portugal, with the highest intakes of fruit and vegetables, both reached a mean intake of about 264 g per day.

No guidelines for how to interpret population goals for this specific age group were identified either. Possibly, children of this age group should end up somewhere in the lower end of the range compared with the range of intake for the whole population. Due to this problem, it was even more difficult to judge to which extent the population of children in this study achieved the WHO population goal.

An attempt was made to use a British example [33] of identifying compliers and noncompliers of the WHO population goal of 400 g. This was done by ranking the sum of vegetable and fruit intake and selecting a cutoff point when the group mean reached 400 g. The cutoff applied in the total group was 210 g, depending on the distribution of intake. In the total sample, the resulting per-



**Table 5.** Percentage of 11-year-old children with fruit plus vegetable intake  $\geq 400$  g, by gender and country

Country	Total		Girls		Boys	
	n	%	n	%	n	%
Austria	400	24.1	212	24.3	188	23.9
Belgium	253	19.1	108	17.8	145	20.3
Denmark	394	21.2	218	23.7	176	18.7
Iceland	92	7.8	36	6.4	56	9.1
Netherlands	130	11.9	77	13.1	53	10.5
Norway	202	17.5	109	19.2	93	15.8
Portugal	453	21.4	227	20.4	226	22.5
Spain	125	9.7	45	7.5	80	11.6
Sweden	250	18.3	136	19.7	114	16.8
Total	2,299	17.6	1,168	17.9	1,131	17.3

percentage of compliers (which should be 100% if the population goal was achieved) was 44.5%. Among the compliers, there were more girls than boys in all countries except for Spain. If, on the other hand, the 400 g population goal is used as a cutoff for fruit and vegetable intake, we can see that the percentage of 11-year-olds in the 9 countries that eat 400 g of fruits and vegetables per day varies between 6.4 and 24.3%, depending on gender and country (table 5).

National recommendations were in most cases higher than the WHO population goal (table 1). In some countries, fruit juice without limitation was included in the recommendation, while other countries allowed the inclusion of one portion of fruit juice per day, interpreted as 100 g. Yet other countries did not include fruit juice at all. In all countries, except for Norway, potatoes were excluded from the recommendations. Some countries used the same recommendations for adults and children. The recommendations sometimes included guidelines for interpretation of survey results; Spain, Denmark and Portugal specified that portions were supposed to be used for evaluation of intake. When taking all these factors into account, the average intake in all countries failed to reach the own nationally recommended levels in this study.

For those countries which used portions for evaluating intake, 6.0 and 5.8% of girls and boys in Denmark, 19.5 and 13.3% in Norway, 23.2 and 22.2% in Portugal and 0.8 and 1.2% in Spain reached the recommended number of portions for fruit and vegetables. Comparison of the Norwegian data with national recommendations was however difficult as potato intake was not measured in this study.

The Dutch and Belgian recommendations are expressed both in grams (for vegetables) and portions (for fruit). For the Netherlands 7.8 and 5.7%, and for Belgium 14.0 and 13.3% of girls and boys, respectively, reached both recommendations for fruit and vegetables.

For Austria 6.4 and 7.6%, for Iceland 3.4 and 4.6% and for Sweden 15.7 and 13.3% of girls and boys reached the recommended intakes, which ranged from 400 to 600 g. According to the National Food Administration in Sweden, the recommendation for fruit and vegetables for Sweden (1/2 kg) should be seen as a population goal, which means that half of the whole population should reach the recommendation.

In the above calculations, fruit juice was not counted at all. This could mean that the results were too pessimistic in many cases, since fruit juice could have contributed to a higher intake of for example folate and vitamin C than indicated by the data on fruit and vegetables.

## Conclusions

The average fruit and vegetable intake did not reach WHO population goals or national recommendations in any country when fruit juice was excluded. The fruit and vegetable intake was highly variable across Europe, for total amounts and types of vegetables eaten. Vegetable intake was clearly lower than fruit intake. A large proportion of the investigated group stated a frequency of intake which was less than once a day of fruit and vegetables, respectively.

The future analysis of determinants for fruit and vegetable intake in the Pro Children cross-sectional survey will be of great importance for identifying ways to correct the inadequate intakes that were identified in this analysis.

We can also conclude that there were difficulties in the interpretation of the WHO population goal, since no clear guidelines seemed to exist regarding (1) the inclusion or exclusion of fruit juice and (2) interpretation within selected age groups. Moreover, national recommendations are highly variable and sometimes difficult to interpret.

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