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Fruit and vegetable consumption in a sample of 11-year-old children in ten European countries – the PRO GREENS cross-sectional survey

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Abstract

Objective: To describe fruit and vegetable intake of 11-year-old children in ten European countries and compare it with current dietary guidelines.

Design: Cross-sectional survey. Intake was assessed using a previously validated questionnaire containing a pre-coded 24 h recall and an FFQ which were completed in the classroom. Portion sizes were calculated using a standardized protocol.

Setting: Surveys were performed in schools regionally selected in eight countries and nationally representative in two countries.

Subjects: A total of 8158 children from 236 schools across Europe participating in the PRO GREENS project.

Results: The total mean consumption of fruit and vegetables was between 220 and 345 g/d in the ten participating countries. Mean intakes did not reach the WHO population goal of ≥ 400 g/d in any of the participating countries. Girls had a significantly higher intake of total fruit and vegetables than boys in five of the countries (Sweden, Finland, Iceland, Bulgaria and Slovenia). Mean total fruit intake ranged between 114 and 240 g/d and vegetable intake between 73 and 141 g/d. When using the level ≥ 400 g/d as a cut-off, only 23·5 % (13·8–37·0 %) of the studied children, depending on country and gender, met the WHO recommendation (fruit juice excluded).

Conclusions: Fruit and vegetable consumption was below recommended levels among the schoolchildren in all countries and vegetable intake was lower than fruit intake. The survey shows that there is a need for promotional activities to improve fruit and vegetable consumption in this age group.

Keywords
Fruit and vegetable consumption
Children
Europe

It has been recognized for some time that fruit and vegetables (F&V) constitute an essential part of a healthy diet[1–3]. High consumption of F&V has been associated with a decreased risk of morbidity and mortality from a number of chronic diseases like CHD[4], stroke[5], type 2 diabetes[6] and certain cancers[7]. F&V are low in energy

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but contain high amounts of essential nutrients, phytochemicals, dietary fibre and other bioactive compounds that have health-promoting properties[8].

The WHO recommends eating a minimum of 400 g of F&V per day[9], but few children in Europe seem to reach this target according to the previous Pro Children survey[10] performed in nine European countries in 2003. The 2007 report of the World Cancer Research Fund/American Institute for Cancer Research also proposed an individual consumption of non-starchy vegetables and fruits of over 400 g/d[3]. National food-based dietary guidelines for F&V intake can be found in all participating countries[11–20] and most of them are higher than the WHO or World Cancer Research Fund/American Institute for Cancer Research recommendations. The different country recommendations are, however, very diverse and use different approaches to formulating dietary guidelines.

Food habits early in life tend to track to a certain extent into adulthood[21–23], which is why it is important to promote F&V consumption among children and adolescents. Therefore, several school-based or family-based initiatives have been implemented in order to promote F&V intake among schoolchildren[24–28]. These programmes had a positive effect on actual intake levels among this target group in the countries where they were implemented. In order to build further on these programmes and strategies, we need to re-assess the current intake levels among this age group and also disseminate and implement the research tools in other countries in Europe.

The PRO GREENS project was designed to assess actual levels of fruit intake and vegetable intake among 11-year-old schoolchildren in ten European countries (Bulgaria, Finland, Germany, Greece, Iceland, Norway, Portugal, Slovenia, Sweden and the Netherlands). The age group 11-year-olds was chosen since it is a critical time point before adolescence and because it is an age group that is able to complete a questionnaire with some rigour[29]. In addition, the age group made it possible to intervene and follow-up in the schools while minimizing the risk of children changing schools before the end of the intervention. The aims also included to further investigate the determinants of intake and to develop and test feasible, effective and sustainable strategies to promote F&V consumption among schoolchildren. The project builds on methods and results from the Pro Children survey, the first ever cross-national comparison of F&V intake performed in children in Europe[30]. In PRO GREENS, five countries that participated in the previous Pro Children survey and five additional countries, including three new EU member states (Bulgaria, Greece and Slovenia), teamed up to provide new information about the F&V intake levels of schoolchildren in Europe and to spread the use of the validated methodology of assessment of F&V intake. So far, little is known about the consumption of F&V in children in the new member states.

The aim of the current paper was to present the findings from the PRO GREENS baseline survey with regard to the current consumption levels of fruit and of vegetables in a sample of 11-year-old children in ten countries in Europe and compare the results with the current WHO recommendations.

Methods

Sampling

The baseline cross-sectional survey was performed during April to October 2009 in the ten countries (Bulgaria, Finland, Germany, Greece, Iceland, Norway, Portugal, Slovenia, Sweden and the Netherlands). Sampling of schools was performed regionally in all countries except in Slovenia and the Netherlands, where the samples were nationally representative. In Bulgaria, Finland, Iceland, Norway and Sweden, schools were selected in the capital regions or in restricted areas. In Finland, only Swedish-speaking schools were included. In Germany, Greece and Portugal, the selection of schools was made in close vicinity to the research centres (Porto, Heraklion and Giessen). The total sample is not representative for the whole of Europe.

From each country, an original sample selection of at least 1000 children was included. The sample was considered large enough not only for the survey reported here but also to serve as the baseline measurement of the subsequent intervention study. For this latter study, the sample will be randomly assigned to an intervention and control group (at the school level). The number of children was sufficient to detect a difference in consumption between the intervention and control group of 20 g/d given a mean intake of 200 g/d, a standard deviation of 175 g/d and α error level of 5 % to reach a power of 80 %.

Ethical considerations

Self-administered questionnaires were the only research instrument used and participation was voluntary. All participating research centres obtained ethical approval from local or national research ethics committees before conducting the survey. Parental consent was in some countries retrieved prior to including the children in the cross-sectional survey, in other countries afterwards. Parents were either contacted directly by mail if home addresses had been provided by the school, or reached through the class teacher. In Norway, data safety authorities were involved, in accordance with national regulations.

Instrument

The validated Pro Children questionnaire[29] was modified slightly, translated if needed into each local language and used for assessing the F&V intake in all countries. Berries were added and some small adjustments were made to the lunch meal question in order to better capture lunch eaten

in school as well as lunch eaten at home and to make it fit circumstances around the lunch meal in all participating countries better. The questionnaire constitutes a pre-coded 24 h recall component with detailed questions regarding yesterday's intake of fruit and of vegetables and a food-frequency component with questions about usual F&V intake. Quantities in grams per day were estimated according to a protocol described elsewhere[29]. The children completed the questionnaire in the classroom with help from the teacher or research staff. Vegetable intake was divided into four categories; raw, salad, cooked and soup vegetables. Raw vegetables included whole, cut-up or sliced vegetables like carrot sticks, tomatoes, slices of bell pepper, cucumber, etc. served separately (not as part of a salad). Salad vegetables included mixed uncooked vegetables, sliced, grated or chopped. Cooked vegetables included boiled, fried or baked vegetables. One portion of vegetable soup (250 g was considered to include 80 g of soup vegetables.

Data handling

A data management handbook was developed, based on the Pro Children data management handbook[28]. A child was regarded as a non-participant if he/she had completely misunderstood the questionnaire. The 24 h recalls were defined as incomplete if more than three out of ten answers were missing on questions regarding fruit, raw vegetables, salad or cooked vegetables (e.g. 'Did you eat fruit yesterday before school?' yes/no; Table 1). If three or fewer answers were missing the intake was coded as 0 for the missing answers. Missing values on individual questions were in most cases low (<2 %) although in one case (Germany) the number of missing values was in some cases as high as 8 %.

Maximum portions were set for 'berries' and 'other fruits' as children sometimes misunderstood how to report the amount of these food items; reported intake above three portions was set to a maximum intake of three portions. Outliers, less than 1 % of participants, had a calculated intake corresponding to more than 1200 g F&V/d.

Fruit juice was not included in the analysis since it was shown in focus groups that children have difficulties distinguishing fruit juice from other fruit-based and -flavoured beverages[31]. Potatoes, dried fruit, nuts and canned fruit were not included. We did not ask about vegetables included in composite dishes (e.g. carrot cake), except for vegetable soup and salads.

Statistical analysis

Data analysis was performed using the statistical software package IBM SPSS Statistics 20·0. Methods for calculating portions and amounts have been described in more detail elsewhere[29]. The statistical significance for differences in intake between boys and girls was set as $P<0{\cdot}05$. Data from the 24 h recall showed a large skewed distribution due to the large number of zeros (child did not eat fruit or vegetables on the day of data collection). Therefore, the non-parametric Mann–Whitney U test was used to compare intakes between girls and boys. The Kruskal–Wallis test was used to compare intake across countries. Next, *post hoc* pair-wise multiple comparisons (non-parametric) were performed for which adjusted P values were calculated in order to control the type I error ($P_{adj} = PK(K-1)/2$). Proportions of children meeting the recommendations were compared across countries using the χ^2 test and multiple pair-wise comparisons, adjusted with the Bonferroni correction.

When analysing data for the whole sample all children were included; however, for analysis on girls and boys separately, three children were excluded since only the children with known gender could be included.

Results

Participation rates

A total of 8158 children were included in the final database. One hundred and sixty-one questionnaires were excluded from the analysis due to exclusion criteria

Table 1 Sample selection, response rates and data cleaning description by country for 236 schools across ten European countries participating in the PRO GREENS project, April–October 2009

	Sampled schools	Participating schools	Eligible sample	Response rate		Data entry		Data included in the analysis		
Country	*n*	*n*	*n*	*n*	% of part	*n*	% of part	*n*	% of part	% of data entry
Bulgaria	12	12	1174	1091	92·9	985	83·9	963	82·0	97·8
Finland	19	19	1123	1071	95·4	950	84·6	934	83·2	98·3
Germany	45	14	1300	816	62·8	803	61·8	784	60·3	97·6
Greece	53	40	972	920	94·7	905	93·1	892	91·8	98·6
Iceland	24	19	1036	805	77·7	720	69·5	702	67·8	97·5
Norway	104	15	934	590	63·2	505	54·1	479	51·3	94·9
Portugal	5	5	979	931	95·1	898	91·7	883	90·2	98·3
Slovenia	44	33	1509	1392	92·2	1233	81·7	1218	80·7	98·8
Sweden	86	26	1234	737	59·7	737	59·7	726	58·8	98·5
The Netherlands	414	53	1046	589	56·3	584	55·8	577	55·2	98·8
TOTAL	806	236	11 307	8942	79·1	8320	73·6	8158	72·2	98·1

described above (Table 1). The mean age of the participating children was 11·3 (SD 0·5) years.

Twenty-four-hour recall

Intake of total F&V, intake of fruit and intake of vegetables separately from the 24 h recall are presented in Table 2. The mean intake of total F&V ranged between 220 and 345 g/d in the ten participating countries. Girls had a significantly higher intake of total F&V than boys in five of the countries (Bulgaria, Finland, Iceland, Slovenia and Sweden). The highest mean of total F&V intake was found in Norway and Bulgaria (345 and 320 g/d, respectively) who had a significantly higher intake than all the other countries except for Sweden (291 g/d). The countries with

Table 2 Total fruit and vegetable (F&V) intake, fruit intake and vegetable intake among 11-year-old children (*n* 8158) from 236 schools across ten European countries participating in the PRO GREENS project, April–October 2009. Results based on the 24 h recall in g/d, showing mean, standard deviation, median, 25th percentile (P25) and 75th percentile (P75) values. *P* values are shown for gender differences

		Total F&V intake (g/d)						Girls		Boys		
Country	*n*	Mean	SD	Median	P25	P75	Pair-wise comparisons*	Mean	Median	Mean	Median	*P* value
a) Total F&V intake												
Bulgaria	963	320	264	280	105	460	a	337	300	300	220	0·001
Finland	934	220	199	170	80	300	e	231	190	209	150	0·005
Germany	784	267	263	200	80	380	c,d,e	269	200	264	190	0·215
Greece	892	280	258	210	90	400	b,c	270	200	290	230	0·213
Iceland	702	231	212	180	80	340	d,e	254	200	206	150	0·001
Norway	479	345	290	280	100	515	a	349	300	344	265	0·477
Portugal	883	249	196	210	100	360	c,d	253	208	246	210	0·580
Slovenia	1218	226	213	180	80	320	e	242	200	208	160	0·002
Sweden	726	291	233	248	114	410	a,b	319	275	262	225	0·000
The Netherlands	577	242	258	200	100	320	c,d,e	245	200	239	180	0·196
TOTAL	8158	263	237	200	100	375	*P* < 0·001†	274	220	252	200	<0·001
		Fruit intake (g/d)						Girls		Boys		
Country	*n*	Mean	SD	Median	P25	P75	Pair-wise comparison‡	Mean	Median	Mean	Median	*P* value
b) Fruit intake												
Bulgaria	963	197	202	150	0	300	b	204	200	189	100	0·019
Finland	934	114	138	100	0	200	e	120	100	107	100	0·034
Germany	784	168	190	100	0	200	c,d	164	100	172	100	0·871
Greece	892	178	186	100	0	250	b,c	170	100	186	150	0·130
Iceland	702	137	132	100	0	200	c,d	171	100	139	100	0·002
Norway	479	240	223	200	50	400	a	240	200	240	200	0·957
Portugal	883	137	132	100	0	200	d	137	100	136	100	0·747
Slovenia	1218	152	164	100	0	200	c,d	160	100	143	100	0·016
Sweden	726	150	155	100	0	200	b,c,d	162	100	138	100	0·003
The Netherlands	577	159	174	100	0	200	c,d	159	100	159	100	0·783
TOTAL	8158	161	175	100	0	200	*P* < 0·001†	166	100	157	100	<0·001
		Vegetable intake (g/d)						Girls		Boys		
Country	*n*	Mean	SD	Median	P25	P75	Pair-wise comparisons§	Mean	Median	Mean	Median	*P* value
c) Vegetable intake												
Bulgaria	963	123	122	90	40	180	a,b	133	100	111	80	0·000
Finland	934	106	114	80	29	145	b	111	80	102	80	0·062
Germany	784	99	135	50	0	140	c,d	105	60	93	40	0·034
Greece	892	101	131	60	0	140	c	99	60	104	60	0·819
Iceland	702	75	106	40	0	105	d	83	50	67	40	0·003
Norway	479	105	145	50	0	158	c,d	107	50	103	58	0·586
Portugal	883	112	106	80	16	160	a,b	116	80	110	80	0·237
Slovenia	1218	73	91	40	0	105	d	82	40	65	40	0·000
Sweden	726	141	148	100	40	190	a	157	120	124	80	0·000
The Netherlands	577	83	108	60	0	120	c,d	85	60	80	60	0·010
TOTAL	8158	101	121	65	0	145	*P* > 0·001†	107	80	95	60	<0·001

*Pair-wise comparisons, adjusted significance levels. Countries for which intake levels are significantly different are denoted with different letters a–e (e.g. total F&V intake in Bulgaria differs from intake in Finland, but not from intake in Norway and Sweden).
†Result from the non-parametric Kruskal-Wallis test.
‡Pair-wise comparisons, adjusted significance levels. Countries for which intake levels are significantly different are denoted with different letters a–e (e.g. fruit intake in Bulgaria differs from intake in Finland, but not from intake in Greece and Sweden).
§Pair-wise comparisons, adjusted significance levels. Countries for which intake levels are significantly different are denoted with different letters a–e (e.g. vegetable intake in Bulgaria differs from intake in Germany, but not from intake in Finland, Portugal and Sweden).

the lowest total F&V intake were Iceland, Slovenia and Finland (231, 226 and 220 g/d, respectively). The children in Sweden had the highest vegetable intake (141 g/d), while children in Norway had the highest fruit intake (240 g/d). Compared with boys, girls had a significantly higher intake of total F&V as well as of fruit separately in Bulgaria, Finland, Iceland, Slovenia and Sweden, and a significantly higher vegetable intake in Bulgaria, Germany, Iceland, Slovenia, Sweden and the Netherlands.

The vegetable intake proportional by preparation method is shown in Fig. 1. There was a large variation in the types of vegetables consumed when comparing the Nordic countries with e.g. Portugal and Bulgaria. The two countries that differed most from the rest were Portugal and Sweden. Compared with any other country, Swedish children consumed proportionally more raw vegetables. Slovenia and Portugal had proportionally the lowest intake of raw vegetables and significantly lower than all countries except the Netherlands. Children in Portugal consumed proportionally more soup vegetables compared with all the other countries, followed by Slovenia that had a significantly higher intake of soup vegetables than all countries except Portugal, the Netherlands and Germany.

The mean consumption of total F&V was below the WHO recommended amounts in all countries included. When the WHO recommendation of ≥400 g/d was used as a cut-off for intake, the percentage of children who reached this target was 13·8–37·0 % depending on country and gender, and 23·5 % of the whole sample (Table 3).

FFQ

Reported frequencies of fruit and vegetable intakes are presented separately in Fig. 2. There is a large variation between countries in how many children report eating

Table 3 Percentage with total fruit and vegetable (F&V) intake ≥400 g/d by gender and country among 11-year-old children (*n* 8158) from 236 schools across ten European countries participating in the PRO GREENS project, April–October 2009

	Total F&V intake ≥ 400 g/d		Girls	Boys
Country	%	Pair-wise comparisons*	%	%
Bulgaria	31·7	a,b	33·7	29·3
Finland	13·8	d	14·4	13·2
Germany	23·9	c	23·6	24·2
Greece	26·0	c	23·3	28·8
Iceland	19·5	c,d	22·2	16·7
Norway	37·0	a	38·2	35·6
Portugal	21·0	c	22·3	19·7
Slovenia	16·8	d	17·9	15·7
Sweden	26·0	b,c	31·0	21·1
The Netherlands	19·1	c,d	21·0	17·0
TOTAL	23·5		24·8	22·1

*Pair-wise comparisons with Bonferroni correction. Countries for which percentages meeting the recommendation are significantly different are denoted with different letters a–e (e.g. percentage meeting the recommendation in Bulgaria differs from that in Finland, but not from that in Norway and Sweden).

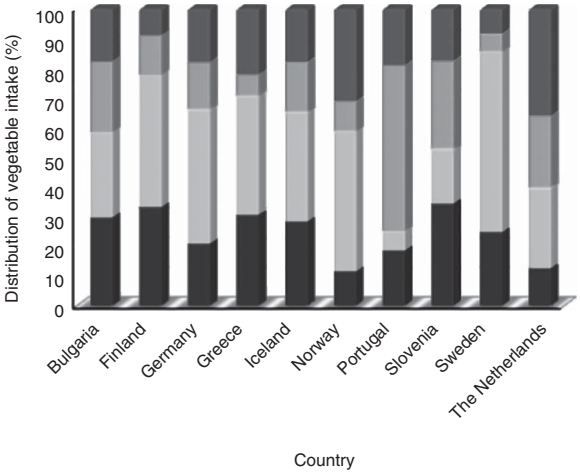

Fig. 1 Mean distribution (%) of vegetable intake by preparation method and type (■, cooked vegetables; ■, soup vegetables; ■, raw vegetables; ■, salad vegetables) per country (24 h recall) among 11-year-old children (*n* 8158) from 236 schools across ten European countries participating in the PRO GREENS project, April–October 2009

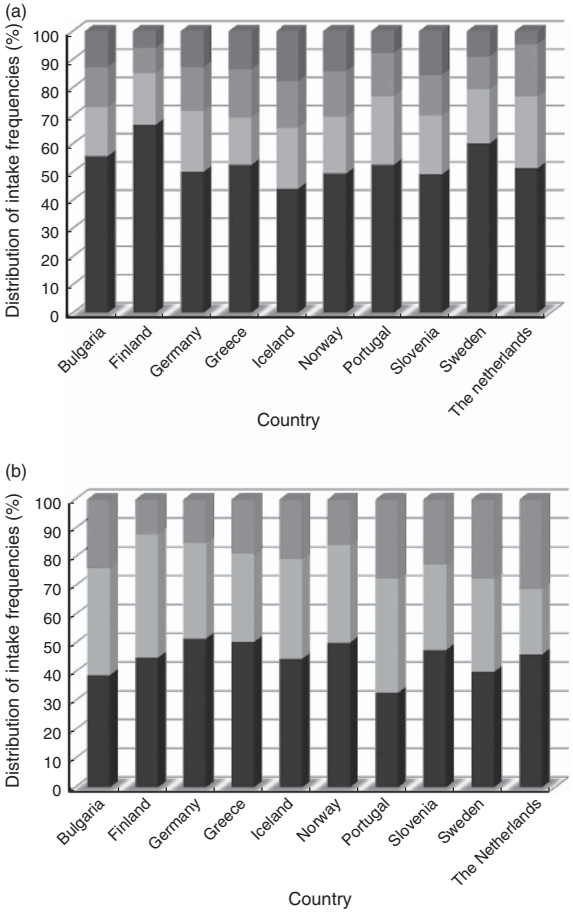

Fig. 2 Distribution (%) of intake frequencies (times per day) of (a) fruits (■, > 2 times/d; ■, 2 times/d; ■, 1 time/d; ■, < 1 time/d) and (b) vegetables (■, ≥ 2 times/d; ■, 1 time/d; ■, < 1 time/d) per country (FFQ) among 11-year-old children (*n* 8158) from 236 schools across ten European countries participating in the PRO GREENS project, April–October 2009

fruit once daily or more. On average 53·3 % of the children reported not to eat fruit daily. Iceland was the country where the largest proportion of children (55·8 %) reported eating fruit at least once daily, in contrast to the results from the 24 h recall, where children in Iceland had the second lowest intake of fruit. The country where the largest proportion of children reported eating vegetables at least once daily was Finland (67·0 %), and the country where the smallest proportion of children reported eating vegetables at least once daily was Norway (48·2 %). On average, 44·9 % of the children reported eating vegetables less than once daily.

Discussion

The main results showed that children in the investigated countries still do not meet the recommendations for F&V consumption, with only 23·5 % of the whole sample reaching the WHO recommendation of 400 g/d. More than half (53·3 %) of the children in the total survey reported not eating fruit daily, while the corresponding results for vegetables were slightly more promising according to the FFQ (44·9 %). There were relatively large variations in total F&V intake between countries and also when looking at fruit and vegetable intakes separately, as well as consumption of different types and preparations of vegetables between countries. The mean and median intakes were low in all countries, especially the vegetable intakes. Boys had a lower intake of both fruit and vegetables in general, with the exception of some countries (Germany and Greece for fruit, Greece and Portugal for vegetables) where results showed a tendency of the opposite. The Pro Children study also revealed a gender difference with a lower F&V intake in boys in the countries studied[10]. In Germany, the findings differ slightly from those of a population-wide consumption survey[32], which found a mean daily F&V intake of 230 g in boys and 259 g in girls aged 11 years. The mean gender difference of 10 g/d might reflect regional, ethnic and economic aspects of the study population in PRO GREENS.

In most F&V recommendations, fruit juice is included, either unlimited or up to a certain amount[10]. The evidence for the benefits of fruit juice is, however, much less clear than for F&V. F&V are higher in fibre and less concentrated in sugar and there is even some evidence indicating an increased risk of type 2 diabetes with a high consumption of juice in adults[33]. When comparing the intakes of the group of children participating in the current study with the recommendations, one needs to keep in mind that the intakes most likely would be slightly higher if intake of fruit juice were included. As described in the Methods section, an additional reason why we did not include fruit juice in the calculations was that it was shown in focus group interviews that children had problems distinguishing between real fruit juice and other fruit-based or -flavoured drinks, like lemonade and sodas[31]. However, national intake recommendations are in most cases higher than the WHO population goal of ≥400 g/d and the WHO recommendation does not specify whether fruit juice should be included.

The vegetable intake was lower than the fruit intake in all countries. Children often tend to like fruit better than vegetables and may find fruit more accessible as a snack. The low vegetable intake may also be due to a low availability and/or accessibility at home or in school[10,34]. The types of vegetables consumed and how they were prepared and served varied significantly between the countries included, which was also seen in the Pro Children study[10]. In the Nordic countries (Finland, Iceland, Norway and Sweden) the most commonly eaten types of vegetables were raw vegetables. Especially in Portugal but also in Bulgaria and Slovenia to a certain extent, soup vegetables were more commonly eaten than in the other countries. The type and preparation method of vegetables affects several factors, such as the matrix of the vegetable, which may hinder uptake; but also heat, exposure to oxygen and/or light, cutting, diffusion, homogenization and fat used during processing can change the nutrient level and/or bioavailability in cooked *v.* raw vegetables[35–37]. The bioavailability of carotenoids is greatly increased by cooking or homogenization and the total antioxidant capacity of vegetables increases, probably due to matrix softening and increased possibilities to extract and absorb the compounds of antioxidant nature[35,36]. Ascorbic acid and other water-soluble vitamins and vitamin-like components in vegetables do, however, diffuse into cooking liquids and some are destroyed by heat[37]. The choice of cooked or raw vegetables, which the current study shows to differ between countries, most likely depends on cultural factors and availability at home or at school lunch and not necessarily or primarily the preference of the child. Since vegetable intake seems to be the most difficult to increase in a number of intervention studies[28], knowledge regarding the most common type of vegetables and the way they are served might provide useful information to tailor future interventions promoting vegetable intake.

The intake levels observed in the present survey are considerably higher than intakes measured in the previous European survey, Pro Children[10] in 2003. The mean intakes of total F&V were between 220 and 345 g/d in the present study (231–345 g/d in the Pro Children countries also participating in PRO GREENS and 220–320 g/d in the new countries in PRO GREENS) and in the Pro Children survey intakes were 143–265 g/d (143–264 g/d in the five countries also participating in the current study). These results are however not directly comparable, since different sampling methods were used in the two studies. In Pro Children all countries except for two (Austria and Belgium) had nationally representative samples. Intake levels especially in Norway and especially for fruit seem to

have increased substantially (in Pro Children 149 g/d, in the present study 240 g/d). The fact that the sampling method in Norway was different for the two studies may have affected the results, but it is also likely that the several promotional programmes to increase F&V intake that have been run in Norway in the period 2003 to 2009[27] have had an effect. The fact that children's F&V intake was based on child reports, which may evoke socially desirable answers, might result in over-reporting, especially in a country where campaigns have been most widespread and intense. In a study by Fischer *et al.* mediation analyses showed that knowledge of the recommendations, parental demand and parental facilitation explained most of this difference in fruit intake in the Netherlands between 2003 and 2009. This suggests that school programmes and/or media activities were able to raise awareness among both children and parents[38].

Earlier national dietary surveys including F&V intake in the participating countries were generally in line with the results from the current study[25,26,39–45]. Results from the FFQ in the current study also showed a similar pattern for fruit intake as the latest Health Behaviour in School-Aged Children survey (HBSC)[46]. Among the PRO GREENS countries included in the HBSC study, Finland reported the lowest percentage of children eating fruit at least once daily, while Iceland, Norway, Portugal and Slovenia were among the countries with the highest percentage of children reporting eating fruit once daily or more according to the HBSC, results in agreement with our data.

The presence or absence of a school meal in some of the countries may partially explain differences between countries in the present study[47]. For example, Germany, the Netherlands and Norway have no school meals. Instead, children bring a packed lunch to school (the Netherlands, Norway) or eat lunch after school at home (Germany). It is likely that the average packed lunch does not always contain vegetables. The amount of vegetables eaten in school may also vary drastically between schools and countries where school meals are served depending on school meal quality. In Sweden, where the vegetable intake is the highest among the countries in the present study, the school lunch and its salad bar play an important role. Finland offers a similar school lunch to Sweden, which could contribute to why Finnish children consumed more vegetables than the average sample, while the fruit consumption was the lowest of all participating countries. Further studies are needed to confirm the factors behind the differences in consumption between countries. In Norway, a lot of effort has been made to provide fruit in school and to promote fruit breaks in class, which could explain the high fruit intake in the Norwegian sample.

When interpreting the current findings, some limitations need to be taken into account. The sample in the study was not nationally population representative, with the exception of Slovenia and the Netherlands. Therefore it is not possible to draw a general conclusion regarding the overall situation in the eight countries with regional samples. Since participation in the study was done on a voluntary basis, schools actually participating were likely more inclined to be aware of and interested in healthy eating. This may have positively affected the consumption or the responses. Some countries (especially Norway, but also Iceland, Sweden and the Netherlands) had low response rates among schools, which could have introduced a selection bias. If this was the case, the true representative intake levels for the selected region may likely be lower than reported here. This might partially explain why Norway, in contrast to the results in the Pro Children study, had the highest fruit intake as well as total F&V intake in the current study, since it might be the case that only the schools that had a larger interest in this topic, and subsequently a higher intake, chose to participate.

Most countries performed the survey during the period April–June in 2009. Due to difficulties in recruiting schools and delays in obtaining parental consent, the time of assessment was delayed in Norway, Sweden and Iceland to September–October. The seasonal effect could have had an impact on intake levels in these countries compared with the others, since locally grown F&V are more available during the autumn in Scandinavia.

The main limitation of the assessment method was that intakes were recorded for one weekday only in the precoded 24 h recall instrument and that the results therefore did not reflect usual individual intake. However, on a group level, this method is more reliable and can be considered to reflect average intake of the group. The FFQ should to some extent reflect usual intake better, but on comparison, the ranking of countries based on actual intake (24 h recall) differed quite substantially from the ranking of usual intake (FFQ). The differences in ranking of countries for actual intake compared with usual intake could be due to the problem with portion size estimation, both in the 24 h recall but also that frequencies of intakes did not take portion sizes into account.

Our study clearly showed that interventions are needed to promote F&V consumption in this age group. From earlier studies such as the Pro Children study[24,30] we know that these interventions should target the most important and modifiable determinants of F&V intake. Home and school availability is a very important facilitating determinant of F&V intake and the subsequent PRO GREENS intervention will address this. Furthermore, our study meant that the Pro Children tool was translated into another four languages (German, Bulgarian, Greek and Slovenian), a questionnaire that can be used for free over Europe[48]. PRO GREENS also adds knowledge about the current intake levels of fruit and of vegetables among samples of children in ten European countries measured with a validated questionnaire especially designed to assess F&V intake, and additionally new information about intake in five countries not previously included in a similar study.

Conclusions

The present cross-sectional survey shows that the mean consumption levels of F&V in this sample of 11-year-old children were not reaching the WHO population goal. A large number of children stated a frequency of less than once daily for fruit intake and vegetable intake. Vegetable intake was even lower than the fruit intake, which shows the importance of focusing promotional efforts in this field. Despite not reaching population goals for intake of F&V, results from some countries show positive and promising indications, especially in Norway where it seems that the many promotional programmes over the past decade might have had an effect on fruit intake. In order to draw any definite conclusions nationally representative surveys need to be conducted.

The future analyses of the intervention study based on these data will provide more information about the potential of strategies for F&V promotion among children in Europe.

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