CORA Cork Open Research Archive
Cartlann Taighde Oscailte Chorcaí

Title	The role of fruit and vegetables in the diets of children in Europe: Current state of knowledge on dietary recommendations, intakes and contribution to energy and nutrient intakes
Authors	McCarthy, Róisín;Kehoe, Laura;Flynn, Albert;Walton, Janette
Publication date	2020-08-13
Original Citation	McCarthy, R., Kehoe, L., Flynn, A. and Walton, J. (2020) 'The role of fruit and vegetables in the diets of children in Europe: Current state of knowledge on dietary recommendations, intakes and contribution to energy and nutrient intakes', Proceedings of the Nutrition Society, 79(4), pp. 479-486. doi: 10.1017/S0029665120007090
Type of publication	Article (peer-reviewed)
Link to publisher's version	10.1017/S0029665120007090
Rights	© 2020, the Authors. Published by Cambridge University Press on behalf of The Nutrition Society. This material is free to view and download for personal use only. Not for re-distribution, re-sale or use in derivative works.
Download date	2026-11-04 18:02:51
Item downloaded from	https://hdl.handle.net/10468/12245

UCC
University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

Proceedings of the Nutrition Society (2020), **79**, 479–486 doi:10.1017/S0029665120007090
© The Author(s), 2020. Published by Cambridge University Press on behalf of The Nutrition Society. First published online 13 August 2020

The 13th European Nutrition Conference (2019) was held at the Convention Centre, Dublin on 15–18 October 2019

Conference on 'Malnutrition in an obese world: European perspectives' Postgraduate Competition

The role of fruit and vegetables in the diets of children in Europe: current state of knowledge on dietary recommendations, intakes and contribution to energy and nutrient intakes

Róisín McCarthy[1], Laura Kehoe[1]*, Albert Flynn[1] and Janette Walton[1,2]
[1]*School of Food and Nutritional Sciences, University College Cork, Cork, Republic of Ireland*
[2]*Department of Biological Sciences, Cork Institute of Technology, Cork, Republic of Ireland*

Fruit and vegetables (F&V) play an important role in the prevention of obesity and other chronic diseases and low intakes have been highlighted as one of the risk factors attributing to global mortality in adults. The childhood years are a critical period during which eating behaviours and food preferences evolve, providing an opportunity to develop and foster healthy eating practices, which carry into adulthood. This review aimed to summarise dietary guidelines relating to F&V, intakes of F&V and the contribution of F&V to energy and nutrient intakes in school-aged children in Europe. The current review showed a paucity of data in relation to guidelines specific for children for F&V consumption. Where guidelines were available, they ranged from 100 to 500 g or one to three portions of F&V daily (with variations in the categorisations). A key finding was the lack of data on estimates of F&V intakes in school-aged children across Europe. Where data were available, intakes ranged from 221 to 404 g/d and were generally below the WHO recommendation of at least 400 g/d. F&V contributed low proportions of energy intake (6–9 %) but made significant contributions to intakes of dietary fibre (19–37 %), vitamin A (26–46 %), vitamin C (32–83 %) and potassium (16–27 %); however, they also contributed to intakes of total (25–50 %) and free sugar (7–11 %). This review has highlighted the need for more data on estimates of F&V intakes in school-aged children in Europe and a need for continued promotion of F&V consumption to increase intakes in this age group.

Dietary guidelines: Fruit: Vegetables: Energy: Nutrients

On-going research suggests that changes in current dietary patterns including an increased consumption of plant-based foods will provide major health benefits and will support a more sustainable environment[1–4]. In particular, higher intakes of fruit and vegetables (F&V) has been associated with a lower risk of obesity and other chronic diseases and low intakes have been highlighted as one of the risk factors attributing to global mortality in adults (about 2·6 million deaths per year)[5,6]. While most research on health outcomes of F&V intake is in adults, the childhood years are a critical period during which eating behaviours and food preferences evolve, providing an opportunity to develop and foster healthy eating practices, which carry into adulthood[7,8].

Vegetables have been defined as the edible parts of the plant which include stems and stalks, roots, tubers, bulbs, leaves, flowers and fruits[9]. Fruits are a subgroup of vegetables containing seeds and pulpy surrounding tissue and are generally consumed raw as a breakfast, snack or

Abbreviations: FBDG, food-based dietary guidelines; F&V, fruit and vegetables.
***Corresponding author:** Laura Kehoe, email laura.kehoe@ucc.ie

Downloaded from https://www.cambridge.org/core. University College Cork, on 22 Nov 2021 at 14:14:56, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0029665120007090

dessert while vegetables can be consumed raw or cooked with a main dish, in a mixed dish or in a salad[9]. Due to their low energy density and high concentration of dietary fibre, vitamins and minerals, F&V are often grouped together and hold an important place in food-based dietary guidelines (FBDG) worldwide[10–12]. The WHO recommends a minimum intake of 400 g (five portions) of F&V daily (excluding potatoes and other starchy tubers) for the general healthy population[5]. However, individual countries develop their own FBDG which have been compiled in a comprehensive database by the FAO[13]. There is a need to understand the role of F&V in the diet including compliance with guidelines and the contribution of F&V to nutrient intakes.

This review aimed to summarise dietary guidelines relating to F&V, intakes of F&V and the contribution of F&V to energy and nutrient intakes in school-aged children in Europe. In order to review the dietary guidelines across Europe, the FAO database was used to source the FBDG of all European countries and guidelines were included if they were accessible online, included F&V and were published in English. For F&V intake and contribution to nutrient intakes, data are included from nationally representative dietary surveys published as reports, online web pages or peer-reviewed journal articles. For inclusion in this review, the studies must be published in English, conducted post 2000 and have collected dietary intake data at an individual level via either food records or 24 h recalls.

Guidelines for fruit and vegetable consumption in Europe

The comprehensive database from the FAO was reviewed with regard to guidance on F&V consumption for children in European countries and the findings are presented in Table 1. A key finding of this review was that there is a lack of data in relation to guidelines specific for children for F&V consumption. Denmark, Finland, Greece, the Netherlands and Norway are the only countries that provide guidelines for F&V consumption specific for school-aged children (4–13 years) with recommendations ranging from 100 to 500 g or one to three portions of F&V daily[14–18]. Many countries in Europe (including Austria, Bulgaria, France, Georgia, Germany, Ireland, Italy, Sweden, the UK and Turkey) instead have adopted the WHO recommendation for F&V consumption which is aimed at the general population (including children) and recommends an intake of a minimum of 400 g of F&V (excluding potatoes and other starchy tubers)[19–29].

Whilst there is some variation in the quantities recommended for F&V consumption, particularly for children, there are also differences with regard to the inclusion/exclusion of individual components such as fruit juice, potatoes, dried fruit, nuts, legumes, tinned/canned fruit or vegetables and mushrooms in country-specific guidelines (Table 2).

For fruit juice, the majority of countries in Europe (except for the Netherlands, Finland and Sweden) limit fruit juice to one portion of fruit with varying quantities (100, 125, 150, 200 ml and unlimited quantity)[14–25,27–29]. Dried fruit is included as a portion of fruit with varying quantities (e.g. 25 g, 30 g, 1½ tablespoons, ½ cup, etc.) in Bulgaria, France, Germany, Greece, Ireland, the Netherlands and the UK[16,17,20,21,23–25,28]. Nuts (25 g) are included as a portion of fruit in Germany, but not in any other country reviewed[23].

The majority of countries in Europe do not include pulses and legumes as part of their guideline for vegetable consumption with the exception of Austria and Germany where legumes are included in varying quantities (70–200 g/d)[19,23]. Potatoes are included as a portion of vegetables in Turkey, but not in any other countries reviewed[29]. Tinned/canned fruit or vegetables are included in the recommendations in Bulgaria, Denmark, Ireland, Norway and the Netherlands[14,17,18,20,24,25]. Interestingly, Denmark does not include mushrooms as part of their guidelines for vegetable consumption due to the high content of natural toxins (phenylhydrazine derivatives), while all other countries do[14].

Fruit and vegetable consumption in children in Europe

Comparison of studies

This review of national dietary surveys of school-aged children in Europe found that very few countries have data on F&V intakes. Data on F&V intakes and the contribution of F&V to energy and nutrient intakes were available only for Denmark, Ireland, Italy, Spain, the Netherlands and the UK[30–41].

When comparing F&V intakes between countries, it is important to acknowledge the previously mentioned variation in the categorisation of F&V between countries. Additionally, as F&V (in particular vegetables) are often consumed as part of a composite dish, F&V components from composite dishes should be included to ensure best estimates. It has previously been shown that excluding the vegetable component of composite dishes may underestimate vegetable intakes by up to 52 % in children aged 1–12 years[42,43]. To the best of the author's knowledge, F&V from composite dishes have been included in estimates of intakes in all countries included in this review.

Fruit and vegetable intakes and contribution to energy and nutrient intakes

Using data from national dietary surveys in Europe, the intakes of F&V in school-aged children (3–12 years) are presented in Table 3. Intakes of F&V for children in Ireland, the Netherlands and the UK ranged from 221 to 272 g/d, while intakes in Italy and Spain ranged from 341 to 350 g/d and intakes in Denmark were 404 g/d[30–35]. Despite the different classifications of F&V intakes between countries in Europe, intakes can be broadly compared with the WHO guideline to consume a minimum of 400 g F&V[5]. Intakes of F&V in children were below the WHO guideline for all countries apart from Denmark where children aged 4–9 years had intakes of 404 g/d[30]. In light of changing food consumption patterns, it is important to continue to monitor

Downloaded from https://www.cambridge.org/core. University College Cork, on 22 Nov 2021 at 14:14:56, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms.
https://doi.org/10.1017/S0029665120007090

Table 1. Fruit and vegetable consumption guidelines for children from the food-based dietary guidelines in European countries within the WHO region

Country	Age	Guidance for fruit and vegetable consumption
Denmark[14]	4–10 years	300–500 g fruit and vegetables
Finland[15]	Children	Children should eat at least half the amount recommended for adults
Greece[16]	4–13 years	One to three portions of vegetables daily and one to three portions of fruit daily
The Netherlands[17]	4–13 years	100–150 g/d vegetables and 150–200 g/d fruit
Norway[18]	Children	500 g fruit and vegetables a day (250 g of fruit and 250 g vegetables) and 5 portions of fruit and vegetables with somewhat reduced portion size for children
Austria[19]	General population 2 years+	Five portions of vegetables, pulses and fruit daily (three portions of vegetables and/or pulses and two portions of fruit)
Bulgaria[20]	General population	A variety of vegetables and fruits more than 400 g every day, preferably raw
France[21]	General population	At least five portions of fruit and vegetables daily, three portions of vegetables and two portions of fruits. One portion equals 80 to 100 g
Georgia[22]	General population	Eat variety of fruits and vegetables, minimum 400 g daily
Germany[23]	General population	At least five portions of fruit and vegetables daily (three portions of vegetables and two portions of fruit). Corresponding to 400 g fruit and vegetables daily
Ireland[24,25]	General population 5 years+	At least 5 to 7 servings of fruit & vegetables daily
Italy[26]	General population	At least 400 g fruit and vegetables
Sweden[27]	General population 2 years+	At least 500 g vegetables and fruit daily
The UK[28]	General population 2 years+	At least five portions of fruit and vegetables daily
Turkey[29]	General population	Five or more portions of fruit and vegetable daily
World Health Organisation[5]	General population	A minimum of 400 g fruit & vegetables daily (excluding potatoes and other starchy tubers)

Ministry of Food Agriculture & Fisheries 2013[14], National Nutrition Council Finland 2019[15], Institute of Preventive Environmental & Occupational Medicine, Prolepsis 2014[16], Netherlands Nutrition Centre 2015[17], Norwegian Directorate of Health[18], Austrian Ministry of Health and the National Nutrition Commission 2010[19], Bulgarian National Center of Public Health Protection 2006[20], Ministry of Solidarity and Health 2019[21], Ministry of Labor Health and Social Affaires 2005[22], The German Nutrition Society 2013[23], Food Safety Authority of Ireland 2011[24], Department of Health 2017[25], WHO 2000[26], The Swedish National Food Agency 2015[27], Public Health England 2016[28], Republic of Turkey Ministry of Health 2016[29], WHO/FAO[5].

intakes of F&V. Recent time-trend analyses from Ireland (2003/04–2017/18), the Netherlands (2007 to 2012) and the UK (2008/09–2016/17) have shown that while there was no change in overall F&V consumption among children, there was an increase in whole fruit and a decrease in fruit juice intakes in this age group which is in line with public health advice to limit fruit juice intake to reduce free sugar intake[31,34,44,45].

The contribution of F&V to energy and nutrient intakes in school-aged children is presented in Tables 4 and 5. It is important to note that Denmark, Spain and the Netherlands (for micronutrients) included adults in these estimations and hence findings are not specific to children for these countries.

F&V contributed low proportions of energy intake (6–9 %) in all countries reviewed which may be partly explained by the low energy density and low consumption of this food group. F&V contributed relatively small proportions of fat (2–6 %) and protein (4–8 %) and 8–19 % of carbohydrate intakes[30,31,35–37,41]. F&V contributed to significant proportions of dietary fibre intakes (32–37 %) in Denmark, Italy and Spain and contributed to significant but lower proportions in Ireland, the Netherlands and the UK (19–27 %) with fruit contributing to the majority of intakes in Italy (20 %) and vegetables contributing to the majority of intakes in the Netherlands, the UK and Spain (14–18 %) while both F&V contributed similar proportions of dietary fibre in Denmark and Ireland[30,31,35–37,41]. F&V contributed 25–31 % of total sugar intake in Ireland and Italy and to 50 % of total sugar intakes in Spain with fruit contributing to the majority of this intake in Ireland and Italy (16 %) and both fruit (21 %) and, juices and nectars (23 %) contributing to the majority of intakes in Spain[31,36–38]. Fruit juice accounted for 10–11 % of free sugar intake in children in Ireland and the UK and juices and nectars accounted for 7 % of free sugar intake in Spain[30,31,35,37,38].

In terms of vitamins, F&V contributed 50–83 % of vitamin C intakes in Denmark, Ireland, Italy and Spain with fruit contributing to the majority of intakes in Ireland (23 %) and vegetables contributing to the majority of intakes (34–51 %) in other countries[30,31,36,39,41]. F&V contributed lower proportions of vitamin C intakes in the Netherlands (32 %) due to the exclusion of fruit juice when reporting the contribution of F&V to nutrient intakes[41]. For vitamin A, F&V contributed 26–46 % of intakes in Denmark, Ireland, Italy, Spain and the UK with vegetables contributing to the majority of vitamin A intakes (24–36 %)[30,31,35,36,39]. F&V contributed to significant proportions of vitamin E intakes (38 %) in Denmark with relatively lower proportions (9–20 %) in Ireland, Italy, Spain and the Netherlands[30,31,36,39,41]. F&V made significant contributions to intakes of thiamin (9–18 %), riboflavin (5–12 %), niacin (4–10 %), vitamin B_6 (10–25 %) and dietary folate equivalents (14–19 %) in children across Europe with the majority of these intakes coming from vegetables[30,31,35,36,40,41].

Downloaded from https://www.cambridge.org/core. University College Cork, on 22 Nov 2021 at 14:14:56, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms.
https://doi.org/10.1017/S0029665120007090

Downloaded from https://www.cambridge.org/core. University College Cork, on 22 Nov 2021 at 14:14:56, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0029665120007090

Table 2. Categorisation of fruit and vegetables in food-based dietary guidelines in European countries within the WHO region

Country	Fruit juice	Dried fruit	Legumes	Potatoes	Nuts	Tinned fruit and vegetables
Austria[19]	200 ml fruit juice as one portion	–	70–100 g (raw), 150–200 g (cooked)	–	–	–
Bulgaria[20]	Included. Unlimited quantity	Included. No specific quantity given	–	–	–	Included. No specific quantity given
Denmark*[14]	Included. No specific quantity given	–	–	–	–	Included. No specific quantity given
Finland[15]	–	–	–	–	–	–
France[21]	Included. No specific quantity given	Included. No specific quantity given	–	–	–	–
Georgia[22]	A glass of 100 % fruit juice as one portion	–	–	–	–	–
Germany[23]	Included. No specific quantity given	25 g as one portion	75 g (raw), 125 g (cooked)	–	25 g included as one portion of fruit	–
Greece[16]	125 ml fruit juice as one portion	1½ tablespoons raisins, 4 dried fruits as one portion	–	–	–	–
Ireland[24,25]	150 ml unsweetened fruit juice as one portion	½ cup dried fruit as one portion	–	–	–	2/3 cup of tinned fruit
Norway[18]	100 ml fruit juice as one portion	–	Encouraged to eat as vegetables	–	–	Included. No specific quantity given
Sweden[27]	–	–	Encouraged to eat as vegetables	–	–	–
The Netherlands[17]	–	Dried fruit without added sugar as one portion. No specific quantity given	–	–	–	Canned vegetables without added sugar. No specific quantity given
The UK[28]	150 ml unsweetened fruit juice as one portion	30 g as one portion	–	–	–	–
Turkey[29]	Tea glass of juice as one portion	–	–	Included. No specific quantity given	–	–
WHO/FAO[5]	–	–	Included. No specific quantity given	–	–	–

– Data not available.
* excludes mushrooms as part of the guidelines for vegetable consumption.
Austrian Ministry of Health and the National Nutrition Commission 2010[19], Bulgarian National Center of Public Health Protection 2006[20], Ministry of Food Agriculture & Fisheries 2013[14], National Nutrition Council Finland 2019[15], Ministry of Solidarity and HeElth 2019[21], Ministry of Labor Health and Social Affaires 2005[22], The German Nutrition Society 2013[23], Institute of Preventive Environmental & Occupational Medicine, Prolepsis 2014[16], Food Safety Authority of Ireland 2011[24], Department of Health 2017[25], Norwegian Directorate of Health[18], The Swedish National Food Agency 2015[27], Netherlands Nutrition Centre 2015[17], Public Health England 2016[28], Republic of Turkey Ministry of Health 2016[29], WHO/FAO[5].

Table 3. Mean intake (g/d) of fruit and vegetables in school-aged children in Europe from National Dietary Surveys

Country	Study name	Study years	Dietary assessment method	Age	Total	Boys (g/d)	Girls
Denmark[30]	Danish National Survey of Dietary Habits and Physical Activity	2011–2013	7 d record	4–9 years	404	407	400
Ireland[31]	National Children's Food Survey II (NCFS II)	2017–2018	4 d diary	5–12 years	221	228	215
Italy[32]	Italian National Food Consumption Survey	2005–2006	3-d diary	4–9 years	350	–	–
Spain[33]	Anthropometry, Intake and Energy Balance in Spain (ANIBES)	2009	3 d diary	9–12 years	341	329	359
The Netherlands[34]	The Dutch National Food Consumption Survey (DNFCS)	2012–2016	2 × 24 h recalls	4–8 years	272	–	–
The UK[35]	National Diet and Nutrition Survey (NDNS)	2014–2016	4 d diary	4–10 years	255	256	255

Pedersen *et al*. 2014[30], IUNA, 2019[31], Leclerq *et al*. 2009[32], Partearroyo *et al*. 2019[33], Van Rossum *et al*. 2016[34], Public Health England, 2018[35].

Table 4. The contribution (%) of fruit and vegetables to energy and nutrient intakes in children in Europe from National Dietary Surveys

	Denmark[30] (4–75 years)	Ireland[31] (5–12 years)	Italy[36] (3–10 years)	Spain[37–40] (9–12 years and 9–75 years)†	The Netherlands*[41] (7–69 years)	The UK[35] (4–10 years)
Energy	6	7	8	9	7	9
Protein	6	4	4	4	5	8
Total fat	–	2	2	–	6	3
Saturated fat	4	1	1	–	0	1
Carbohydrate	19	11	12	16	8	13
Total sugars	–	25	31	50	–	–
Free sugars	–	11	–	7	–	12
Dietary fibre	36	19	37	32	25	27
Vitamin A	26	28	46	38	–	28
Vitamin D	–	0	1	–	–	0
Vitamin E	38	9	20	16	11	–
Vitamin C	74	50	83	71	32	–
Thiamin	15	15	13	18	9	–
Riboflavin	10	5	12	11	6	8
Total Niacin	10	4	–	9	–	–
Vitamin B_6	25	13	20	25	10	–
Vitamin B_{12}	–	0	–	–	–	–
Dietary folate equivalents	–	14	–	–	19	–
Sodium	5	2	–	–	–	5
Potassium	27	17	29	–	16	20
Calcium	8	4	9	–	7	7
Iron	15	7	18	–	12	12
Magnesium	16	12	19	–	12	17
Zinc	7	4	11	9	7	7

– Data not available.
* Does not include fruit juice.
† Macronutrient data is reported for 9–12 years old while micronutrient data is for 9–75 years old collectively.
Pedersen *et al*. 2014[30], IUNA, 2019[31], Sette *et al*. 2013[36], Ruiz *et al*. 2016[37], Ruiz *et al*. 2017[38], Olza *et al*. 2017[39], Mielgo-Ayuso *et al*. 2018[40], Van Rossum *et al*. 2011[41], Public Health England 2018[35].

As expected, due to vitamin B_{12} being found in animal sources only, F&V did not contribute to vitamin B_{12} intakes in children across Europe[36,41].

For mineral intakes, F&V contributed 16–27 % of potassium intakes in Denmark, Ireland, Italy, the Netherlands and the UK with vegetables contributing to the majority of these intakes in Denmark, Italy and the Netherlands (9–15 %) and fruit contributing the majority of intakes in Ireland and the UK (9 %)[30,31,35,36,41]. F&V contributed to small proportions of iron (7–18 %), magnesium (12–19 %), calcium (4–9 %) and zinc (4–11 %) intakes in children across Europe[30,31,35,36,41].

Strategies to increase fruit and vegetable intakes

Given the importance of F&V in FBDG and with low intakes generally observed across European populations, public health strategies have been introduced to increase the intake of F&V in population groups including children[11,12]. These include programmes such as

Downloaded from https://www.cambridge.org/core. University College Cork, on 22 Nov 2021 at 14:14:56, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms.
https://doi.org/10.1017/S0029665120007090

Table 5. The contribution (%) of fruit, fruit juice (FJ) and vegetables (Veg) to energy and nutrient intakes in children in Europe from National Dietary Surveys

	Denmark[30] (4–75 years)			Ireland[31] (5–12 years)			Italy[36] (3–10 years)			Spain[37–40] (9–12 and 9–75 years)†			The Netherlands*[41] (7–69 years)		The UK[35] (4–10 years)		
	Fruit	FJ	Veg	Fruit	FJ	Veg	Fruit	FJ	Veg	Fruit	FJ	Veg	Fruit	Veg	Fruit	FJ	Veg
Energy	2	1	3	4	1	1	4	2	2	3	3	3	5	2	4	2	3
Protein	2	–	4	1	1	2	1	0	3	1	–	3	3	2	2	2	4
Total fat	–	–	–	1	0	1	1	0	1	–	–	–	5	1	1	–	2
Saturated fat	2	–	2	0	0	0	1	–	0	–	–	–	–	0	0	–	1
Carbohydrate	12	2	5	6	3	2	6	4	2	5	6	6	6	2	7	3	3
Total sugars	–	–	–	16	6	3	16	10	6	21	23	6	–	–	–	–	–
Free sugars	–	–	–	0	10	1	–	–	–	–	7	–	–	–	0	11	1
Dietary fibre	18	–	18	9	1	8	20	1	17	13	1	18	11	14	12	1	14
Vitamin A	2	–	24	1	1	25	9	1	36	7	–	31	–	–	2	1	25
Vitamin D	–	–	–	0	0	0	0	0	1	–	–	–	–	–	0	–	0
Vitamin E	23	–	15	4	1	4	7	2	11	5	–	11	5	6	–	–	–
Vitamin C	25	12	37	23	15	11	23	26	34	20	–	51	16	16	–	–	–
Thiamin	5	2	8	6	5	4	6	2	6	6	–	12	4	5	–	–	–
Riboflavin	4	1	5	2	1	1	4	2	6	4	–	7	2	4	3	3	2
Total Niacin	3	1	6	2	1	2	–	–	–	3	–	6		–	–	–	–
Vitamin B_6	11	2	12	8	2	3	9	2	9	9	–	16	5	5	–	–	–
Vitamin B_{12}	–	–	–	0	0	0	0	0	0	–	–	–	0	0	–	–	–
Dietary folate equivalents	–	–	–	5	3	6	–	–	–	–	–	–	5	14	–	–	–
Sodium	2	–	3	0	0	1	–	–	–	–	–	–	–	–	0		5
Potassium	11	2	14	9	3	5	12	3	15	–	–	–	7	9	9	4	7
Calcium	3	1	4	1	1	2	3	1	5	–	–	–	2	5	2	1	4
Iron	6	1	8	3	1	4	6	3	9	–	–	–	4	8	4	1	7
Magnesium	8	1	7	6	2	4	7	3	9	–	–	–	7	5	7	3	7
Zinc	3	–	4	1	0	2	2	1	8	4	–	5	3	4	2	–	5

– Data not available.
* Does not include fruit juice.
† Macronutrient data are reported for 9–12 years old while micronutrient data are for 9–75 years old collectively.
Pedersen *et al*. 2014[30], IUNA, 2019[31], Sette *et al*. 2013[36], Ruiz *et al*. 2016[37], Ruiz *et al*. 2017[38], Olza *et al*. 2017[39], Mielgo-Ayuso *et al*. 2018[40], Van Rossum *et al*. 2011[41], Public Health England, 2018[35].

Downloaded from https://www.cambridge.org/core. University College Cork, on 22 Nov 2021 at 14:14:56, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0029665120007090

educational and promotional campaigns and implementation of school policies for healthy eating[46–50].

In line with the FBDG, '5 a day' and similar campaigns have been set up in many countries to promote the consumption of F&V using communication and media events, and educational programmes[46]. Across Europe, the EU school scheme supports the distribution of products, educational measures and information measures with regard to healthy eating including the consumption of F&V[49]. In addition, some countries have implemented school food policies to promote F&V within the school setting such as provision of fruit at break times and in vending machines (at low cost) and promotional material for F&V within the school[48]. Other EU projects such as EU FRUITS and Cultivating the Taste of Europe have been implemented to promote the production and consumption of F&V through education and promotional activities in European countries[47,50].

Conclusion

This review aimed to summarise dietary guidelines relating to F&V, intakes of F&V and the contribution of F&V to energy and nutrient intakes in school-aged children in Europe. Few countries provide guidelines specific for children for F&V consumption in Europe with recommendations ranging from 100 to 500 g or one to three portions of F&V daily. Most other countries have adopted the WHO guideline of at least 400 g/d for the general population including children. Differences were noted in the categorisation of F&V within FBDG for individual countries, for example, the inclusion/exclusion of fruit juice, potatoes, dried fruit, nuts, legumes, tinned/canned fruit or vegetables and mushrooms.

A key finding of this review was that only six European countries have data on F&V intakes in nationally representative samples of school-aged children. Where data were available, F&V intakes in European children are generally below the WHO recommendations with the exception of Denmark. F&V contributed low proportions of energy intake (6–9 %) but made significant contributions to intakes of dietary fibre (19–37 %), vitamins A (26–46 %), vitamin C (32–83 %) and potassium (16–27 %); however, they also contributed to intakes of total (25–50 %) and free sugar (7–11 %).

This review has highlighted the need for continued promotion of F&V consumption for school-aged children and more data on estimates of F&V intakes in this age group in European countries. The present review provides a comprehensive overview of the role of F&V in the diets of children in Europe and may be of use to stakeholders including researchers and policy makers.

Acknowledgements

The authors would like to thank the Irish section of the Nutrition Society and the Federation of European Nutrition Societies for inviting the present review paper as part of the postgraduate review competition.

Financial Support

This work was supported by funding from the Irish Department of Agriculture Food and the Marine.

Conflicts of Interest

None.

Authorship

R. McC. contributed to the design of the study, data analyses and wrote the first draft. All authors contributed to the writing of the final manuscript. All authors critically reviewed the manuscript and approved the final version submitted for publication.

References

1. Willett W, Rockström J, Loken B, *et al.* (2019) Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet* **18**, 1–3.
2. Ostfeld RJ (2017) Definition of a plant-based diet and overview of this special issue. *Journal of Geriatric Cardiology: JGC* **14**, 315.
3. Satija A & Hu FB (2018) Plant-based diets and cardiovascular health. *Trends Cardiovasc Med* **28**, 437–441.
4. McEvoy CT, Temple N & Woodside JV (2012) Vegetarian diets, low-meat diets and health: a review. *Public Health Nutr* **15**, 2287–2294.
5. WHO/FAO (2004) *Fruit and Vegetables for Health, Report of a Joint FAO/WHO Workshop*. Kobe, Japan: World Health Organization and Food and Agriculture Organization of the United Nations.
6. World Health Organization (2002). *The World Health Report Reducing Risks, Promoting Healthy Life*. Geneva, Switzerland: World Health Organization.
7. Kelder SH, Perry CL, Klepp KI *et al.* (1994) Longitudinal tracking of adolescent smoking, physical activity, and food choice behaviors. *Am J Public Health* **84**, 1121–1126.
8. Birch L, Savage JS & Ventura A (2007) Influences on the development of children's eating behaviours: from infancy to adolescence. *Can J Diet Pract Res* **68**, 1–56.
9. IARC (2003) *Handbooks of Cancer Prevention. Fruit and Vegetables*. Lyon: World Health Organisation and International Agency for Research on Cancer.
10. USDA (2015) 2015–2020 Dietary guidelines for Americans. U.S. Department of Health and Human Services and U.S. Department of Agriculture.
11. Slavin JL & Lloyd B (2012) Health benefits of fruits and vegetables. *Advances in Nutrition (Bethesda, MD)* **3**, 506–516.
12. Herforth A, Arimond M, Álvarez-Sánchez C *et al.* (2019) A global review of food-based dietary guidelines. *Adv Nutr* **10**, 590–605.
13. Food and Agriculture Organisation of the United Nation (2019) Food-based dietary guidelines. Available from: http://www.fao.org/nutrition/education/food-dietary-guidelines/home/en/.

Downloaded from https://www.cambridge.org/core. University College Cork, on 22 Nov 2021 at 14:14:56, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms.
https://doi.org/10.1017/S0029665120007090

Proceedings of the Nutrition Society

14. Ministry of Food Agriculture & Fisheries (2013) Food based dietary guidelines. Glostrup, Denmark: Danish Veterinary and Food Administration.
15. National Nutrition Council Finland (2019) Eating together – food recommendations for families with children. Helsinki, Finland: National Institute for Health and Welfare in Finland.
16. Institute of Preventive Environmental & Occupational Medicine Prolepsis (2014) National dietary guidelines for infants, children and adolescents, Marousi, Greece. Available at: http://www.diatrofikoiodigoi.gr/
17. Netherlands Nutrition Centre (2015) Dutch dietary guidelines. Available at: https://www.voedingscentrum.nl/
18. Norwegian Directorate of Health (2016) Dietary advice and nutrients. Available at: https://www.helsedirektoratet.no/tema/folkehelse-ernaering-og-fysisk-aktivitet
19. Austrian Ministry of Health and the National Nutrition Commission (2010) The food pyramid in detail – 7 steps to health. Available at: https://www.ages.at/en/topics/nutrition/the-austrian-food-pyramid/#
20. Bulgarian National Center of Public Health Protection (2006) Food based dietary guidelines for Adults in Bulgaria. Sofia, Bulgaria: Ministry of Health National Center of Public Health Protection.
21. Ministry of Solidarity and Health (2019) Manger Bouger, National Health Nutrition Program. Paris, France. Available at: https://www.mangerbouger.fr/
22. Public Health Department, Ministry of Labor Health and Social Affaires and World Health Organization (2005) *Healthy Eating-The Main Key to Health for Georgia*. Tblisi, Georgia: National Centre for Disease Control and Public Health.
23. The German Nutrition Society (2013) The 10 rules of DGE. Available at: https://www.dge.de/
24. Food Safety Authority of Ireland (2011) Scientific recommendations for healthy eating guidelines in Ireland. Dublin: Food Safety Authority of Ireland.
25. Department of Health (2017) Healthy eating, food safety and food legislation. A guide supporting the Healthy Ireland Food Pyramid. Dublin: Department of Health and the Food Safety Authority of Ireland.
26. World Health Organization (2000) The countrywide integrated noncommunicable disease intervention (CINDI) dietary guide. Copenhagen, Denmark: WHO Regional Office for Europe.
27. The Swedish National Food Agency (2015) Swedish dietary guidelines – risk and benefit management report. Uppsala, Sweden: Swedish National Food Agency.
28. Public Health England (2016) *From Plate to Guide: What, Why and How for the Eatwell Model*. London, UK: Public Health England & Food Standards Agency.
29. Republic of Turkey Ministry of Health (2016) Turkey dietary guidelines. Ankara: Public Health Agency of Turkey.
30. Pedersen AN, Christensen T, Matthiessen J *et al.* (2014) Danish National Survey of Dietary habits and Physical Activity (DANSDA) (2011–2013). Denmark: DTU Food Institute, Department of Nutrition.
31. Irish Universities Nutrition Alliance (2019) National Children's Food Survey II Main Report. Available from: https://www.iuna.net/surveyreports.
32. Leclercq C, Arcella D, Piccinelli R *et al.* (2009) The Italian National Food Consumption Survey INRAN-SCAI 2005–06: main results in terms of food consumption. *Public Health Nutr* **12**, 2504–2532.
33. Partearroyo T, Samaniego-Vaesken M, Ruiz E *et al.* (2019) Current food consumption amongst the Spanish ANIBES study population. *Nutrients* **11**, 2663.
34. Van Rossum CTM, Buurma-Rethans EJM, Vennemann FBC *et al.* (2016) The diet of the Dutch. Results of the first two years of the Dutch National Food Consumption Survey 2012–2016. The Netherlands National Institute for Public Health and the Environment.
35. Public Health England (2018) National Diet and Nutrition Survey results from years 7 and 8 (combined) of the Rolling Programme (2014/2015 to 2015/2016). London, UK: Public Health England and the Food Standards Agency.
36. Sette S, Le Donne C, Piccinelli R *et al.* (2013) The third National Food Consumption Survey, INRAN-SCAI 2005–06: major dietary sources of nutrients in Italy. *Int J Food Sci Nutr* **64**, 1014–1021.
37. Ruiz E, Ávila JM, Valero T *et al.* (2016) Macronutrient distribution and dietary sources in the Spanish population: findings from the ANIBES study. *Nutrients* **8**, 177.
38. Ruiz E, Rodriguez P, Valero T *et al.* (2017) Dietary intake of individual (free and intrinsic) sugars and food sources in the Spanish population: findings from the ANIBES study. *Nutrients* **9**, 10–14.
39. Olza J, Aranceta-Bartrina J, Gonzalez-Gross M *et al.* (2017) Reported dietary intake and food sources of zinc, selenium, and vitamins A, E and C in the Spanish population: findings from the ANIBES study. *Nutrients* **9**, 10–11.
40. Mielgo-Ayuso J, Aparicio-Ugarriza R, Olza J *et al.* (2018) Dietary intake and food sources of niacin, riboflavin, thiamin and vitamin B6 in a representative sample of the Spanish population. The ANIBES study. *Nutrients* **10**, 846.
41. Van Rossum CTM, Fransen HP, Verkaik-Kloosterman J *et al.* (2011) Dutch National Food Consumption Survey 2007–2010. Diet of children and adults aged 7 to 69 years. Bilthoven, The Netherlands: The National Institute for Public Health and the Environment.
42. O'Connor L, Walton J & Flynn A (2016) Fruit and vegetable intakes, sources and contribution to total diet in very young children (1–4 years): the Irish National Pre-School Nutrition Survey. *Br J Nutr* **115**, 2196–2202.
43. McCarthy R, Kehoe L, Walton J *et al.* (2018) Intakes of fruit and vegetables in Irish children (5–12 years). *Proc Nutr Soc* **77**, E82.
44. Public Health England (2019) National Diet and Nutrition Survey years 1 to 9 of the Rolling Programme (2008–2009–2016/2017): time trend and income analyses. London: Public Health England and Food Standards Agency.
45. World Health Organization (2015) *Sugars Intake for Adults and Children*. Geneva, Switzerland: World Health Organization.
46. The European Fresh Produce Association (2020) Freshfel Europe '5 a day' campaign Brussels. Available from: https://enjoyfresh.eu/php/didyouknow/list.php?doc_id=28.
47. European Commission (2018) EU_Fruits. Available from: https://ec.europa.eu/chafea/agri/en/campaigns/eufruits.
48. JRC (2014) *Mapping of National School Food Policies across the EU28 plus Norway and Sweden*. Luxembourg: Publications Office of the European Union.
49. European Commission (2017) School fruit, vegetables and milk scheme. Available from: https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/market-measures/school-fruit-vegetables-and-milk-scheme/school-scheme-explained_en#documents.
50. European Commission (2018) EUFV – Cultivating the Taste of Europe (CuTE). Available from: https://ec.europa.eu/chafea/agri/en/campaigns/eufv-cute.

Downloaded from https://www.cambridge.org/core. University College Cork, on 22 Nov 2021 at 14:14:56, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S0029665120007090