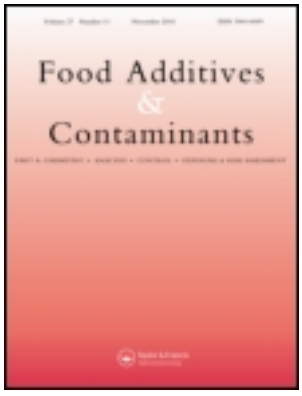

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Methodological characteristics of the national dietary surveys carried out in the European Union as included in the European Food Safety Authority (EFSA) Comprehensive European Food Consumption Database

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Methodological characteristics of the national dietary surveys carried out in the European Union as included in the European Food Safety Authority (EFSA) Comprehensive European Food Consumption Database

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In 2009 competent organisations in the European Union provided the European Food Safety Authority (EFSA) with data from the most recent national dietary survey at the level of individuals' consumption. Twenty different Member States provided EFSA with data from 22 different national dietary surveys, with consumption figures for adults and, when available, for children. Member States' dietary data were assembled into the EFSA Comprehensive European Food Consumption Database. In this paper an overview of the methodologies and protocols employed in the different national dietary surveys is provided. Specifically, details about dietary assessment methods, interview administration, sampling design, portion size estimation, dietary software, evaluation of under-reporting and non-dietary information collected are described. This information is crucial to evaluate the level of accuracy of food consumption data and to anticipate and acknowledge the utmost important sources of heterogeneity of national databases included in the Comprehensive Database. The Comprehensive Database constitutes a unique resource for the estimation of consumption figures across the European Union and represents a useful tool to assess dietary exposure to hazardous substances and nutrient intake in Europe. Nevertheless, the many substantial methodological differences that characterise the Comprehensive Database are acknowledged and critically discussed.

Keywords: exposure assessment; nutrition

Introduction

Food consumption data reflect what individuals or population groups consume in terms of foods, beverages, including drinking water, and supplements. Food consumption in a population can be estimated through surveys at individual level (individual dietary surveys) or household level (household budget surveys). Alternatively, consumption figures might be approximated through food supply data derived from food balance sheets. Individual dietary surveys are the only surveys that provide information on the distribution of food consumption in well-defined groups of individuals and are therefore preferred for the assessment of dietary exposure within the risk assessment process. Data from individual dietary surveys are also assumed to reflect more closely actual consumption (Kroes et al. 2002). National dietary surveys are presently carried out in many European countries and provide valuable information to be used in national policy and in nutritional surveillance.

In 2007, the European Food Safety Authority (EFSA) established the Expert Group on Food Consumption Data (EGFCD), an EFSA network with representatives from each European Union Member State to provide a platform for discussion ultimately to define practical guideline steps for the collection and collation of food consumption data. At the end of 2008, EFSA started a project aimed at establishing the EFSA Comprehensive European Food Consumption Database (known as the Comprehensive Database). Within this project competent organisations, nominated in each Member State by the Permanent Representative to the European Union, were requested to provide EFSA with data from the most recent national dietary survey in their country.

In October 2009, the EGFCD endorsed the guidelines of EFSA on 'Methods and protocols for the collection of national food consumption data in the view of a pan-European dietary survey' (EFSA 2009).

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The main objective of this guideline is to recommend general principles for the collection of dietary information to estimate the intake of foods and nutrients to perform risk assessment for a variety of biological agents and chemical substances evaluated by EFSA Scientific Panels.

The aim of this paper is to give an overview of the different methodologies used for the collection of food consumption and related data included in the Comprehensive Database. This information is crucial to evaluate the level of accuracy of food consumption data and to anticipate and acknowledge utmost important sources of heterogeneity for the comparison of these data at the European level. Such knowledge will assist with realising estimates of uncertainty when assessing exposure to hazardous substances.

Materials and methods

Twenty Member States signed a collaboration agreement with EFSA for the provision and processing of dietary data collected through national surveys. The information provided made the establishment of the Comprehensive Database possible. In order to be included in the database, the dietary data had to be collected at the individual level by means of (replicates of) 24-h dietary recalls or dietary records. Dietary surveys were requested to be representative at the national level, at least for the adult population. The consumption data should be provided at the most disaggregated level recorded. All participating institutions provided EFSA with a database schema describing their food consumption and related data tables. Based on this information a common data model was developed for the transmission of the food consumption data. Data providers coded all food descriptors present in the food consumption database according to a unique classification system developed by EFSA (EFSA 2011). Data providers were also asked to disaggregate industrially produced composite foods or home-made dishes, such as a ready-made frozen pizza or a home-cooked beef stew, into their main raw ingredients. The transmission of food consumption data was accomplished through an application designed by EFSA, called the Data Collection Framework (DCF).

Data providers systematically compiled a report describing in detail the methodology employed in the dietary survey, according to an agreed protocol with the objective of providing detailed information on each of these sections: dietary method, administration of the interview, sampling design, portion size estimation, dietary software, food coding, evaluation of under-reporting and non-dietary information.

All information contained in the reports was checked for completeness and consistency. When necessary, clarifications were requested from the data providers. Where applicable, information reported was verified against the related food consumption data provided to EFSA.

Results

Twenty different Member States provided food consumption data to EFSA at the individual level collected in 22 different national dietary surveys. Table 1 shows the Member State institutions that implemented the food consumption survey in their respective country. The methodological characteristics of the surveys are presented in Table 2. Five different types of survey methodologies were conducted: 7-day food records were carried out in five surveys, 3-day food records in three surveys, one-day 24-h dietary recalls in six surveys, and 2-day 24-h dietary recalls in seven surveys. In Finland a 48-h dietary recall method was used.

All countries that used 2-day 24-h dietary recalls conducted the interview on 2 non-consecutive days with the exception of the most recent survey in Spain (Spain II), where about 35% of the interviews were conducted on consecutive days. The average length between non-consecutive days ranged from 3 (Spain II) to 79 days (Czech Republic). The food record surveys were consistently conducted on consecutive days.

The methodology used within the studies conducted in Denmark (Groth and Fagt 1997) and France (Lafay et al. 2002) have been reported as validated. In the United Kingdom a doubly labelled water validation study was carried out as part of the feasibility study prior to the main survey.

Fourteen surveys also included the administration of a Food Frequency Questionnaire (FFQ) or of a Food Propensity Questionnaire (FPQ), whereas in Germany a diet history was administered to the same study subjects who completed 24-h dietary recalls. In addition, Germany and Finland collected further dietary information, by means of food records, in a subsample of the study population, whereas an additional 24-h recall was administered to all subjects within the Spain I survey. This information was not transmitted to EFSA.

The methods used for the administration of the interview are presented in Table 3. The number of face-to-face meetings between interviewer and subjects to collect food consumption information varied from none to four meetings. In 15 surveys at least one face-to-face interview took place at the study subject's home. In Ireland subjects were interviewed either at home or at their working place. In Slovakia, Bulgaria II and Finland the interviews were conducted at a medical centre, whereas in Spain II subjects were interviewed either at the university campus, health

Table 1. Basic information on the dietary surveys included in the 'Comprehensive European Food Consumption Database'.

Country	Dietary survey (Acronym)	Institution providing the data	Reference
Austria	Austrian Study on Nutritional Status (ASNS)	Institute of Nutritional Sciences, University of Vienna	Elmadfa et al. (2009)
Belgium	Diet National 2004	Scientific Institute of Public Health	De Vriese et al. (2005).
Bulgaria I	National Survey of Food Intake and Nutritional Status	National Centre of Public Health Protection	Petrova and Angelova (2006)
Bulgaria II	NUTRICHILD	National Centre of Public Health Protection	Petrova et al. (2009)
Czech Republic	SISP04	National Institute of Public Health	Ruprich et al. (2006)
Denmark	Danish National Survey of Dietary Habits and Physical Activity	National Food Institute, Technical University of Denmark	Lyhne et al. (2005)
Estonia	NDS 1997	National Institute for Health Development	Pomerleau et al. (1999)
Finland	FINDIET 2007	National Public Health Institute, Nutrition Unit[a]	Paturi et al. (2008) Reinivuo et al. (2010), Pietinen et al. (2010)
France	INCA2	Agence française de sécurité sanitaire des aliments (AFSSA; French Food Safety Authority)[b]	AFSSA (2009), Lioret et al. (2010), Dubuisson et al. (2010)
Germany	German National Nutrition Survey II (NVS II)	Max Rubner-Institut (Bundesforschungsinstitut für Ernährung und Lebensmittel)	Max Rubner-Institut (MRI) (2008), Krems et al. (2006)
Hungary	National Representative Survey	Hungarian Food Safety Office	Rodler et al. (2005)
Ireland	NSIFCS	Food Safety Authority of Ireland	Kiely et al. (2001), Harrington et al. (2001)
Italy	INRAN-SCAI 2005–06	National Research Institute for Food and Nutrition (INRAN)	Leclercq et al. (2009)
Latvia	EFSA_TEST	Food Centre Food and Veterinary Service of Latvia	Šantare et al. (2008)
The Netherlands	VCP2003	National Institute of Public Health and the Environment, TNO Quality of Life	Ocké et al. (2005)
Poland	IZZ-FAO-2000	National Food and Nutrition Institute	Sekula et al. (2004), Szponar et al. (2001, 2003)
Slovakia	SK MON 2008	Food Research Institute	Not available
Slovenia	CRP-2008	National Institute of Public Health of Slovenia	Gabrijelčič Blenkuš et al. (2009)
Spain I	AESAN-FIAB	Universidad Complutense de Madrid	Requejo et al. (2002)
Spain II	AESAN	Universidad Complutense de Madrid	Ortega et al. (2011)
Sweden	RIKSMATEN 1997–98	Swedish National Food Administration	Becker and Pearson (2002)
United Kingdom	National Diet & Nutrition Survey (NDNS)	Food Standards Agency (FSA)	Henderson et al. (2002)

Notes: [a]Currently the National Institute for Health and Welfare.
[b]Currently the French Agency for Food, Environmental and Occupational Health Safety.

centres or pharmacies where the subjects were also recruited for the study. In the Netherlands the interviews were conducted by telephone without any prior physical contact. In the German study there was only one face-to-face meeting with the subject which aimed to collect information on the sociodemographic status, along with information on nutritional and purchase behaviour, health aspects and anthropometric measures. The 24-h recalls were both conducted by telephone a few weeks later. In Austria no verbal contact with the study subjects was established. The subjects completed a 24-h dietary recall according to documented guidelines and returned it by mail to the study centre (postal survey method). In 13 surveys interviewers had a background in nutrition and in the remaining surveys interviewers were trained staff without a nutrition-related background.

The survey period, sampling strategy and response rate are shown in Table 4. In three surveys (Estonia, Ireland and Sweden) the food consumption data were collected prior to the year 2000. In 16 surveys the study population was sampled at individual level, whereas in the remaining six surveys it was sampled at household level. Sample units were selected randomly in all surveys, but different sampling frames were used. The national population register was the most used sampling frame (in eight surveys). In Spain participants were randomly selected from universities, health centres and pharmacies, whereas in Slovakia subjects were sampled from lists of employees of confectionery and

Table 2. Information on the dietary method used within the dietary surveys.

Country	Method	Number of replicates	Days between non-consecutive replicates, mean (5th–95th percentile)[a]	Additional food frequency (FFQ) or propensity (FPQ) questionnaire[b]
Austria	24-h dietary recall	1	Not applicable	No
Belgium	24-h dietary recall	2	23 (12–42)	Yes
Bulgaria I	24-h dietary recall	1	Not applicable	Yes
Bulgaria II	24-h dietary recall	2	3 (2–5)	Yes
Czech Republic	24-h dietary recall	2	79 (43–141)	Yes
Denmark	Food record	7	Consecutive days	No
Estonia	24-h dietary recall	1	Not applicable	Yes
Finland	48-h dietary recall	1	Not applicable	Yes
France	Food record	7	Consecutive days	No
Germany	24-h dietary recall	2	16 (7–39)	Dietary history
Hungary	Food record	3	Two consecutive days and 1 non-consecutive day[c]	No
Ireland	Food record	7	Consecutive days	Yes, only focused on meat
Italy	Food record	3	Consecutive days	No
Latvia	24-h dietary recall	2	68 (27–106)	Yes
The Netherlands	24-h dietary recall	2	11 (8–17)	Yes
Poland	24-h dietary recall	1	Not applicable	No
Slovakia	24-h dietary recall	1	Not applicable	No
Slovenia	24-h dietary recall	1	Not applicable	Yes
Spain I	Food record	3	Consecutive days	Yes
Spain II	24-h dietary recall	2	3 (1–16)	Yes
Sweden	Food record	7	Consecutive days	No
United Kingdom	Food record	7	Consecutive days	Yes

Notes: [a]Information is extracted from the Comprehensive European Food Consumption Database.
[b]Information was collected by means of FFQ or FPQ but was not transmitted to EFSA.
[c]Two consecutive weekdays and 1 weekend day.

Table 3. Administration of the interview.

Country	Number of meetings	Method of administration	Place of interview	Interviewer with a nutritional background
Austria	0	Post	Not applicable	Not applicable
Belgium	2	Face to face	Home	Yes
Bulgaria I	1	Face to face	Home	Yes
Bulgaria II	2	Face to face	Medical centre	Yes
Czech Republic	2	Face to face	Home	No
Denmark	1	Face to face	Home	No
Estonia	1	Face to face	Home	No
Finland	1	Face to face	Study centre	Yes
France	2	Face to face	Home	Yes
Germany	1[a]	Telephone	Not applicable	No
Hungary	1	Face to face	Home	Yes
Ireland	4	Face to face	Home or work place	Yes
Italy	3	Face to face	Home	No
Latvia	2	Face to face	Home	No
The Netherlands	0	Telephone	Not applicable	Yes
Poland	1	Face to face	Home	No
Slovakia	1	Face to face	Medical centre	Yes
Slovenia	1	Face to face	Home	Yes
Spain I	2	Face to face	Universities, health centre, pharmacies	Yes
Spain II	3	Face to face	Home, universities, health centre, pharmacies	Yes
Sweden	1	Face to face	Home	No
United Kingdom	4	Face to face	Home	No

Note: [a]The meeting was not used for 24-h dietary recall administration.

Table 4. Survey period, sampling design and response rate.

Country	Survey period	Sampling method and sampling frame	Sample unit	Response rate (%)
Austria	May 2005–February 2006	Random from telephone book, job centres, gynaecologists, university	Individual	48
Belgium	February 2004–February 2005	Random from the national population register	Individual	41
Bulgaria I	March 2004–August 2004	Random from the national population register	Individual	85
Bulgaria II	April 2007–August 2007	Random from the register of general practitioner's practices	Individual	78
Czech Republic	November 2003–November 2004	Random from the address register	Household	54
Denmark	June 2000–December 2002	Random from the national population register	Individual	53
Estonia	July 1997–August 1997	Random from the national population register	Individual	67
Finland	January 2007–March 2007	Random from the national population register	Individual	62
France	December 2005–April 2007	Random from the general population census	Household	60
Germany	November 2005–January 2007	Random from the national population register	Individual	42[a]
Hungary	October 2003–December 2003	Random from the general population census	Individual	27
Ireland	October 1997–October 1999	Random from the electoral list	Individual	63
Italy	October 2005–December 2006	Random from the telephone book	Household	33
Latvia	June 2008–November 2008	Random from a consumer panel	Individual	56
The Netherlands	October 2003–December 2003	Random from a consumer panel	Individual	42
Poland	September 2000–November 2000	Random from the sample of the household budget survey	Household	96
Slovakia	January 2008–December 2008	Random among employees of confectionery and bakery manufactures and canteen	Individual	96
Slovenia	September 2007–April 2008	Random from the national population register	Individual	52
Spain I	January 1999–November 2001	Random from the university, health centre, pharmacies	Individual	71
Spain II	January 2009–September 2009	Random from the university, health centre, pharmacies	Individual	28
Sweden	January 1997–January 1998	Random from the national population register	Household	60
United Kingdom	July 2000–June 2001	Random from the postcode address file	Household	47

Note: [a]For the total study.

bakery manufactures. The response rate varied from 27% (Hungary) to 96% (Slovakia and Poland).

In six surveys the target population included children below 10 years of age and in about half of the surveys the target population included adolescents from 10 to 17 years (Table 5). In all surveys, with the exception of Bulgaria II, which focused on children, surveys included the age range of 18–64 years. In nine surveys elderly people from 64 to 74 years were also included. In the Dutch dietary survey only young adults, from 19 to 30 years of age, were included.

The sample size, stratification variables and distribution by gender are shown in Table 6. The sample size across the surveys varied from 410 (Slovenia) to 13,926 (Germany) subjects. The vast majority of the surveys were nationally representative for gender (in 20 surveys), age groups (in 19) and geographical areas (in 15). Six surveys were also representative for urban and rural areas. In addition, the Dutch and Irish data were representative for educational level. Austria was only representative according to employment status. In six countries weighting factors were used to make the sample representative at national level for at least age groups, gender and regions.

The weekday and seasonal representativeness of the surveys are shown in Table 7. In six surveys record or recall days did not evenly cover week and weekends. For example, in Slovakia only 5% of the records for which the consumption date was known related to weekends. Twelve surveys captured consumption figures across all seasons. In the remaining surveys seasonality was not fully covered, with only one season represented in Bulgaria I (spring), Estonia (summer), Hungary (winter) and the Netherlands (autumn).

The applied exclusion criteria are shown in Table 8. The majority of Member States (in 17 surveys) excluded institutionalised persons, such as the elderly in retirement homes or people residing in hospitals, prisons or military barracks. In seven surveys pregnant and breastfeeding women were excluded. Information on the diet of pregnant and breastfeeding women was available only from nine different surveys. In three surveys specific population groups were purposely over-represented, notably children aged 3–17 years in France, teenagers aged 15–18 years and people aged more than 75 years in Belgium, and subjects with a lower education level in the Netherlands.

The methods used to estimate portion size are shown in Table 9. Three surveys were conducted using the weighing method, either as the sole method (UK for food consumed inside the home) or combined with other measurement tools (Ireland and Spain I), to estimate the amount of food consumed. In the British survey, for food eaten outside of home a ruler and information on household measures and known packaging size were used. In the majority of surveys (19) a combination of two or more measurement tools were used and in 16 studies the picture book was used as one of these tools. In all but four (Ireland, Latvia, Slovenia and Estonia) of these 16 surveys a validated or tested picture book was used. EPIC-SOFT picture book was used in four surveys (Belgium, Germany, the Netherlands and Italy). Out of the six surveys in which no picture book was used, two were weighed surveys (UK and Spain I); Austria relied on household measurements only; Spain II was conducted using household measurements and packaging size; while in the Slovakian survey the interviewer estimated portion sizes without any tool but relied only on the subject's description. In Hungary subjects used 'reference tables' to estimate and fill in the portion sizes in the record. Three out of the six dietary surveys including children less than 10 years of age (Bulgaria II, Denmark and Italy) reported the use of a picture book with small portion sizes appropriate for children. The remaining three (Poland, Latvia and France) did not use specific tools for children.

Details of the dietary software and related databases used in the different surveys are presented in Table 10. In Belgium, Germany and the Netherlands EPIC-SOFT (Slimani et al. 1999) was used, in Austria and France an *ad hoc* software using MS Access was developed and used. In all other surveys different software were used. Most countries used integrated portion size databases (in 17 surveys) and integrated standard recipe databases (in 20 surveys). In ten surveys no yield factors were used when breaking down recipes and/or composite dishes into the main raw ingredients. Only Sweden did not disaggregate recipes and/or composite dishes into the main ingredients. In 19 surveys the software links the food consumption databases to food composition databases. With this respect, the EPIC-SOFT program is an exception since it does include food composition information only on macronutrients.

The availability of brand name, household processing and packaging information in each survey per food record are presented in Table 11. Brand information was available only in nine surveys for a percentage of records varying from 1% to 29%. In Germany only a flag variable indicating the availability of the brand name was provided because, at the time of the data transmission, data concerning brand name were still in the cleaning phase. The description of the food incorporated information on brand, household processing and packaging in Ireland and, for some of the food items, in the UK. In these circumstances it was not possible to calculate the percentage of food records including this information. In Finland the brand information is also incorporated directly in the food name. Household processing information was available in 14 surveys for a percentage of records varying from 1% to 45% with the number of different

Table 5. Number of subjects according to age group and gender.

Country	From 0[b] to 1[c] years old[a]		From 1[b] to 3[c] years old[a]		From 3[b] to 6[c] years old[a]		From 6[b] to 10[c] years old[a]		From 10[b] to 18[c] years old[a]		From 18[b] to 64[c] years old[a]		From 64[b] to 74[c] years old[a]		Older than 74[b] years	
	Total	Percentage males	Total	Percentage males	Total	Percentage males	Total	Percentage males	Total	Percentage males	Total	Percentage males	Total	Percentage males	Total	Percentage males
Austria	.	.	.	.	.	.	.	.	.	.	2123	37				
Belgium	.	.	.	.	.	.	.	.	611	48	1356	50	502	49	776	52
Bulgaria I	.	.	.	.	.	.	.	.	162	50	691	48	130	55	221	46
Bulgaria II	861	50	428	51	434	51	.	.	.	.	.	.	.	.	.	.
Czech Republic	.	.	.	.	.	.	.	.	85	51	1666	48	.	.	.	.
Denmark					159	52	331	53	479	48	2821	46	283	50	45	51
Estonia	.	.	.	.	.	.	.	.	.	.	1858	45	8	13	.	.
Finland	.	.	.	.	.	.	.	.	.	.	1575	46	463	49		
France					163	49	319	50	973	46	2276	41	240	42	108	46
Germany	.	.	.	.	.	.	.	.	1011	49	10,419	44	1908	47	588	45
Hungary	.	.	.	.	.	.	.	.	.	.	1074	41	188	39	98	35
Ireland	.	.	.	.	.	.	.	.	.	.	952	50	6	50	.	.
Italy	16	56	36	56	67	49	126	48	247	44	2277	46	302	46	252	31
Latvia	.	.	.	.	.	.	190	50	496	50	1382	50	2	0	.	.
The Netherlands	.	.	.	.	.	.	.	.	.	.	750	47	.	.	.	.
Poland	.	.	79	59	137	48	272	51	666	50	2527	45	316	40	137	37
Slovakia[d]	.	.	.	.	.	.	.	.	1	100	2756	50	2	50	.	.
Slovenia[d]	.	.	.	.	.	.	.	.	.	.	400	49	7	57	.	.
Spain I	.	.	.	.	.	.	.	.	86	55	982	48	.	.	.	.
Spain II	.	.	.	.	.	.	.	.	.	.	418	47	.	.	.	.
Sweden	.	.	.	.	.	.	.	.	7	57	1081	48	112	54	10	50
United Kingdom	.	.	.	.	.	.	.	.	.	.	1724	44	.	.	.	.

Notes: [a]Information was extracted from the Comprehensive European Food Consumption Database.
[b]Included in the age range.
[c]Excluded from the age range.
[d]Subjects are missing because no gender or age information was available.

Table 6. Stratification of the sample and gender distribution.

Country	Age range (years)[a]	Number of subjects[a]	Sample stratification variables				Weighting factors to normalize the sample	Gender[a,b]	
			Gender	Age groups	Geographical areas	Others		Females (%)	Males (%)
Austria	19–64	2123	No	No	No	Employment status	Yes	63	37
Belgium	14–105	3245	Yes	Yes	Yes		Yes	50	50
Bulgaria I	16–95	1204	Yes	Yes	Yes	Urban versus rural residence	No	51	49
Bulgaria II	0.1–5	1723	Yes	Yes	Yes	Urban versus rural residence	No	49	51
Czech Republic	16–64	1751	Yes	Yes	Yes	Urban versus rural residence	No	52	48
Denmark	4–75	4118	Yes	Yes	No		No	53	47
Estonia	19–65	1866	Yes	Yes	No	Urban versus rural residence	No	55	45
Finland	25–74	2038	Yes	Yes	Yes		No	53	47
France	3–79	4079	Yes	Yes	Yes	Size of urban area	Yes	56	44
Germany	14–80	13926	Yes	Yes	Yes		Yes	55	45
Hungary	18–96	1360	Yes	Yes	No		No	60	40
Ireland	20–65	958	Yes	Yes	Yes	Education level, urban versus rural residence, social status, employment status	No	50	50
Italy	0.1–98	3323	No	No	Yes	Household structure	No	45	55
Latvia	7–66	2070	Yes	No	Yes		No	50	50
The Netherlands	19–30	750	Yes	Yes	Yes	Education level	Yes	53	47
Poland	1–96	4134	Yes	Yes	No		No	54	46
Slovakia	17–68	2761	Yes	Yes	Yes		No	50	50
Slovenia	18–65	410	Yes	Yes	No		No	51	49
Spain I	17–60	1068	Yes	Yes	Yes		No	51	49
Spain II	18–60	418	Yes	Yes	Yes	Urban versus rural residence	No	53	47
Sweden	17–79	1210	Yes	Yes	Yes		No	52	48
United Kingdom	19–64	1724	No	No	Yes	Population density and socio-economic status	Yes	56	44

Notes: [a]Information was extracted from the Comprehensive European Food Consumption Database.
[b]Weighting factors to normalize the sample were not used to calculate these percentages.

Table 7. Percentage of record or recall days according to the day of the week and season.

Country	Percentage of record or recall days according to the day of the week[a]			Percentage of record or recall days according to the season[a]				
	Week days	Weekend	Unclassified	Spring, 21 March–21 June	Summer, 22 June–22 September	Fall, 23 September–22 December	Winter, 23 December–20 March	Unclassified
Austria	49	14	37	21	26	25	27	1
Belgium	76	24	0	26	25	27	23	0
Bulgaria I	92	8	0	100	0	0	0	0
Bulgaria II	54	46	0	60	40	0	0	0
Czech Republic	74	26	0	34	23	12	31	0
Denmark	72	28	0	25	26	39	10	0
Estonia	73	27	0	0	100	0	0	0
Finland	67	33	0	9	0	0	91	0
France	71	29	0	20	17	24	39	0
Germany	75	25	0	20	27	40	13	0
Hungary	67[b]	33[b]	0	0	0	0	100	0
Ireland	71	29	0	26	28	27	18	0
Italy	78	22	0	26	24	25	25	0
Latvia	72	28	0	0	49	50	0	0
The Netherlands	71	29	0	0	0	100	0	0
Poland	77	23	0	0	31	69	0	0
Slovakia	78	5	17	23	19	29	7	23
Slovenia	76	24	0	11	14	56	19	0
Spain I	43	30	27	28	7	25	22	17
Spain II	73	26	0	75	19	0	6	0
Sweden	71	29	0	0	0	0	0	100
United Kingdom	71	29	0	31	24	22	23	0

Notes: [a]Information was extracted from the Comprehensive European Food Consumption Database.
[b]Percentages were reported by the national data provider.

Table 8. Exclusion criteria.

Country	Institutionalized subjects excluded	Pregnant and breastfeeding women excluded	Number of breastfeeding women[a]	Number of pregnant women[a]	Over sampled population groups
Austria	Yes	No	Not available	Not available	
Belgium	Yes	No	7	9	Subjects from 15 to 18 and older than 75 years
Bulgaria I	Yes	Yes	Not applicable	Not applicable	No
Bulgaria II	Yes	NA	Not applicable	Not applicable	No
Czech Republic	Yes	No	Not available	Not available	No
Denmark	Yes	No	59	50	No
Estonia	No	Yes	Not applicable	Not applicable	No
Finland	No	No	Not available	22	No
France	Yes	No	20	27	Children
Germany	Yes	No	36	52	No
Hungary	No	No	Not available	Not available	No
Ireland	Yes	Yes	Not applicable	3	No
Italy	Yes	No	10	19	No
Latvia	Yes	Yes	Not applicable	Not applicable	No
The Netherlands	Yes	Yes	Not applicable	Not applicable	Males with a low education level group
Poland	Yes	No	26	23	No
Slovakia	No	No	Not available	Not available	No
Slovenia	Yes	Yes	Not applicable	Not applicable	No
Spain I	Yes	No	0	3	No
Spain II	Yes	No	Not available	0	No
Sweden	Yes	No	16	11	No
United Kingdom	Yes	Yes	Not applicable	Not applicable	No

Note: [a]Information was extracted from the Comprehensive European Food Consumption Database.

Table 9. Portion sizes estimation.

	Portion sizes estimated by...				
Country	Weighing	Picture book	Household measures	Known packaging size	Ruler
Austria	No	No	Yes	No	No
Belgium	No	Yes, based on EPIC-SOFT	Yes	No	No
Bulgaria I	No	Yes, validated	Yes	Yes	No
Bulgaria II	No	Yes, validated	Yes	Yes	No
Czech Republic	No	Yes, tested in a convenient sample	Yes	No	Yes
Denmark	No	Yes, validated	Yes	No	No
Estonia	No	Yes, not validated	Yes	No	No
Finland	No	Yes, validated (Ovaskainen et al. 2008)	Yes	Yes	Yes
France	No	Yes, validated (Le Moullec et al. 1996)	Yes	Yes	No
Germany	No	Yes, based on EPIC-SOFT	Yes	No	No
Hungary	No	No	No	No	No
Ireland	Yes	Yes, not validated	Yes	Yes	No
Italy	No	Yes, based on EPIC-SOFT	Yes	Yes	No
Latvia	No	Yes, not validated	Yes	No	No
The Netherlands	No	Yes, based on EPIC-SOFT	Yes	No	Yes
Poland	No	Yes, tested in a convenient sample	Yes	Yes	No
Slovakia	No	No	No	No	No
Slovenia	No	Yes, not validated	Yes	No	No
Spain I	Yes	No	Yes	Yes	No
Spain II	No	No	Yes	Yes	No
Sweden	No	Yes, validated (Becker et al. 1998)	Yes	No	No
United Kingdom	Yes	No	Yes	Yes	Yes

Table 10. Dietary software and database used.

Country	Dietary software	Database used before providing the data to the European Food Safety Authority (EFSA)			
		Portion size	Standard recipe	Yield factors	Food composition
Austria	MS Access 2003 based on German nutrient data base BLS II.3	Yes	Yes	Yes, from raw to cooked foods	Yes
Belgium	EPIC-SOFT program	Yes	Yes	Yes, from raw to cooked foods[a]	No
Bulgaria I	NUTRICALC	Yes	Yes	Yes, from cooked to raw foods[a]	Yes
Bulgaria II	NUTRICALC	Yes	Yes	Yes, from cooked to raw foods[a]	Yes
Czech Republic	Paradox for Windows	Yes	Yes	Yes, from cooked to raw foods[a]	Yes
Denmark	GIES	Yes	Yes	Yes, from cooked to raw foods[a]	Yes
Estonia	Finnish Micro Nutrica Nutritional Analysis program	Yes	Yes	Yes, from cooked to raw foods[a,b]	Yes
Finland	Finessi	Yes	Yes	Yes, from cooked to raw foods[a,b]	Yes
France	MS Access	Yes	Yes	No	Yes
Germany	EPIC-SOFT program	Yes	Yes	Yes, from raw to cooked foods[a]	Yes
Hungary	NutriCompEtrend	Yes	Yes	Yes, from cooked to raw foods	Yes
Ireland	WISP-DES	Yes	Yes	Yes, from cooked to raw foods[a]	Yes
Italy	INRAN-DIARIO 3.1	Yes	Yes	Yes, from cooked to raw foods[a,b]	Yes
Latvia	PGAIS	No	Yes	Yes, from raw to cooked foods	Yes
The Netherlands	EPIC-SOFT program	Yes	Yes	Yes, from cooked to raw foods[a]	No
Poland	Dieta FAO	Yes	Yes	Yes, from cooked to raw foods[a]	Yes
Slovakia	Alimenta 4.3	No	Yes	Yes, from cooked to raw foods[b]	Yes
Slovenia	Blaise 4.7	No	Yes	Yes, from raw to cooked foods[b]	Yes
Spain I	DIAL software	Yes	Yes	No	Yes
Spain II	DIAL software	Yes	Yes	No	Yes
Sweden[c]	MATs version 4.03	No	No	No	Yes
United Kingdom	Intake 2	No	No	No	Yes

Notes: [a]Yield factors were included in the recipe database.
[b]Only for some foods.
[c]Sweden did not disaggregate their recipes.

processing methods reported in the various surveys varying from one to 24. Packaging information is available from three surveys for a percentage of records varying from 1% to 24%. In Belgium and Spain II the packaging information differentiates between physical characteristics such as carton or metal, whereas in Germany packaging information is available only for two food groups (fat and sauces).

The technique used in the various surveys to identify under-reporters is described in Table 12. In 11 surveys individual-level under-reporters were identified among adults by comparing the ratio of energy intake (EI) to basal metabolic rate (BMR) to Goldberg cut-off points (Goldberg et al. 1991), showing the frequency of under-reporters ranging from 11.7% (in Hungary) to 37.3% (in Finland). The cut-off was corrected on the basis of the physical activity level, as suggested by Black (2000a, 2000b) only in the survey from France. In Italy and the Netherlands under-reporting among adults was assessed at the population level. Under-reporting

Table 11. Additional information on food coding.

Country	Specific information collected on ...		
	Brand (percentage of food records)[a]	Household processing (percentage of food records)[a]	Packaging (percentage of food records)[a]
Austria	3	1	0
Belgium	19	22	24
Bulgaria I	0	25	0
Bulgaria II	0	57	0
Czech Republic	0	0	0
Denmark	0	32	0
Estonia	0	0	0
Finland	0	75	0
France	29	18	0
Germany	13	14	5
Hungary	0	40	0
Ireland°	0	0	0
Italy	27	0	0
Latvia	12	26	0
The Netherlands	21	20	0
Poland	0	45	0
Slovakia	0	0	0
Slovenia	1	1	0
Spain I	0	41	0
Spain II	4	18	1
Sweden	0	0	0
United Kingdom	0	0	0

Note: [a]Information was extracted from the Comprehensive European Food Consumption Database.

Table 12. Method of identification of under-reporters, cut-off values and percentage of under-reporters.

Country	Method	Cut off value	Under-reporters excluded	Under-reporters (%)
Austria	Individual level	0.65 (Goldberg et al. 1991) for adults	Yes	12
Belgium	Individual level	0.965 (Black 2000a) for adults	No	NR[b]
Bulgaria I	Individual level	0.9 (Goldberg et al. 1991) for adults	No	NR
Bulgaria II	None	–	–	
Czech Republic	Individual level	0.96 (Black 2000a) for adults	No	12.8
Denmark	Individual level	1.1 (Goldberg et al. 1991) for adults	No	NR
Estonia	None	–	–	
Finland	Individual level	1 (Goldberg et al. 1991) for adults	No	37.3
France	Individual level	1.01–1.27 (Black 2000b)[a] for adults	No	26.9
Germany	Individual level	–	No	
Hungary	Individual level	1.1 (Goldberg et al. 1991) for adults	Yes	11.7
Ireland	Individual level	1.1 (Goldberg et al. 1991) for adults	No	18.0
Italy	Population level	1.55 (Goldberg et al. 1991) for adults	No	–
Latvia	None	–	–	–
The Netherlands	Population level	1.53 (Goldberg et al. 1991) for adults	No	–
Poland	None	–	–	–
Slovakia	None	–	–	–
Slovenia	None	–	–	–
Spain I	None	–	–	–
Spain II	None	–	–	–
Sweden	Individual level	1.1 (Goldberg et al. 1991) for adults	No	24.7
United Kingdom	None	–	–	–

Notes: [a]Cut-off values defined by Black (2000a) vary according to age and sex, taking into account the specific intra- and inter-individual variability of physical activity levels.
[b]NR, not reported.

among children was only assessed in France by comparing the logarithm of energy intake with the mean minus 3 SDs (standard deviations), and in Italy by examining the means of the ratio of energy intake on estimated energy expenditure distributions. Under-reporters were excluded before transmitting data to EFSA only in the Austrian survey where subjects with a ratio of EI/BMR below 0.65 were excluded.

Information on specific study subjects' long-term dietary pattern (e.g. vegetarian, health related or slimming) had been collected in half the surveys (Table 13). In Germany information on further special diets like halal was collected. Non-dietary information collected within the survey is presented in Table 14. Data on body weight and height were consistently available. In nine surveys direct measurements were taken, while in the remaining self-reported measures were used. In 12 and eight surveys information on study subjects' physical activity level, self-reported by means of questionnaires, and ethnicity were collected, respectively.

Discussion

Dietary method

Only data collected through dietary records and 24-h dietary recalls were accepted for inclusion in the Comprehensive Database. The EGFCD considered both methods suitable for the requirements of providing data at a sufficiently detailed level for the purposes of exposure assessment (EFSA 2009), but differences exist between these two methods. The dietary record method might be a more suitable tool for the elicitation of a greater level of detail but, among others, a potential drawback might be the selection bias due to high illiteracy levels in some minority groups across Europe (Biró et al. 2002). On the other hand, an accurate memorisation of food consumed the preceding day is required for the 24-h dietary recalls method. This might represent a difficult cognitive task for the respondent, in particular for the very young or very old study subjects, and could affect the precision in the quantification of the foods consumed (Thompson and Subar 2001). Six of the countries providing data for the Comprehensive Database collected dietary data on children younger than 10 years. Half these countries used the 24-h recall method and the other half used the dietary record method.

Food consumption data collected on more than one day per subject are required to assess chronic exposure. At least two independent short-term assessment days are needed to apply statistical modelling to estimate habitual intake (Dodd et al. 2006). The EGFCD (EFSA 2009) recommends the collection of dietary information for 2 non-consecutive days for both the 24-h recall and the dietary record methods. Recording days are here considered as non-consecutive if there is an interval of at least 2 weeks between them. Collecting data on non-consecutive days has the

Table 13. Number of subjects according to the different self-reported eating patterns.

Country	Normal diet[a]	Vegetarian diet[a]	Diet related to health condition[a]	Slimming diet[a]	Vegetarian and slimming diet[a]	Unspecified[a]
Austria	2123					0
Belgium	2642	1	331			271
Bulgaria I	863	1	70	116		154
Bulgaria II						1723
Czech Republic	1572	9	86	66		18
Denmark						4118
Estonia						1866
Finland	1377	29	584	26	22	0
France	3167	19	314	181	1	397
Germany	10,839	287	2106	141	1	552[b]
Hungary	1360					0
Ireland	764	9	77	70		38
Italy	3124		80	76		43
Latvia						2070
The Netherlands	691	12	8	24		15
Poland						4134
Slovakia	83					2678
Slovenia	410					0
Spain I	1051		10	1		6
Spain II	398		4	16		0
Sweden	1188	18	2			2
United Kingdom	1333	66		314	11	0

Notes: [a]Information was extracted from the Comprehensive European Food Consumption Database.
[b]In Germany information on further special diets, like halal, was also collected, but here these are considered as unspecified.

Table 14. Non-dietary information.

Country	Body weight and height	Information available on ...		
		Physical activity (percentage of subjects)[a,d]	Education level (percentage of subjects)[a]	Ethnicity (percentage of subjects)[a]
Austria	Estimated	100	100	14
Belgium	Estimated	100	100	0
Bulgaria I	Measured	0	100	100
Bulgaria II	Measured	0	100	100
Czech Republic	Estimated	100	100	0
Denmark	Estimated	0	0	0
Estonia	Estimated	100	100	100
Finland	Measured	0	99	0
France	Measured	74[c]	100	0
Germany	Measured	0	100	0
Hungary	Estimated	0	0	0
Ireland	Measured	100	100	100
Italy	Estimated	0[b]	83	0
Latvia	Estimated	0	100	0
The Netherlands	Estimated	100	100	100
Poland	Measured	0	100	0
Slovakia	Estimated	3	3	6
Slovenia	Estimated	100	99	0
Spain I	Estimated	80	28	0
Spain II	Measured	100	99	0
Sweden	Estimated	0	100	0
United Kingdom	Measured	96	100	100

Notes: [a]Information was extracted from the Comprehensive European Food Consumption Database.
[b]Data were not transmitted to the European Food Safety Authority (EFSA).
[c]The questionnaire was administered only to subjects between 15 and 79 years of age.
[d]Information on physical activity was collected by means of questionnaires within all surveys.

potential advantage of making dietary measurements less prone to correlation between errors in dietary assessments (Kipnis et al. 2003; Day et al. 2004). However, in half the surveys where 24-h dietary recalls were used, information on only a single day was collected per subject. Such data can nevertheless be useful to estimate acute exposure. The seven surveys that used 2-day 24-h recall method were conducted on non-consecutive days, with the exception of Finland where a 48-h dietary recall method was used. In three of these seven surveys the average distance between 2 interview days is below the recommended 2-week interval.

It has been argued that the accuracy of self-reported dietary information may decrease as the number of days increases (Gersovitz et al. 1978; Biró et al. 2002; Moreno et al. 2005; Whybrow et al. 2008). On the other hand, increasing the number of assessment days of a survey affects the distribution of consumption, particularly at the upper tails (EFSA 2006). In particular, increasing the number of survey days (for both recalls and records) has the advantage of reducing the effect of study subjects' day-to-day variation, thus leading to an improved estimation of consumption variability (Willett 1998). As survey duration increases, also the observed percentage of subjects reporting non-zero consumption for commonly and rarely eaten foods becomes larger (Nusser et al. 1995), whereas the observed mean and high percentiles consumption, in consumers only, decreases, as also illustrated by Lambe et al. (2000). Half the surveys using the record methodology in the Comprehensive Database (Denmark, France, Ireland and the UK) collected information for more than 3 days per subject.

Some episodically consumed foods may become of public health concern as a result of a high level of contamination with a given hazardous substance. In order to estimate accurately the usual intake of these foods, additional information on their frequency of consumption could complement 24-h dietary recalls or dietary records (Tooze et al. 2006; Kipnis et al. 2009), as emphasised in the EGFCD (EFSA 2009) guideline. Twelve countries reported using an FFQ or an FPQ along with a 24-h recall or dietary record method. In one country (Ireland) the FFQ focused solely on the intake of meat. Data from FFQ or FPQ may be used in acute exposure assessments to assess the proportion of consumers of a given food, and in chronic exposure assessments to determine the frequency distribution of the consumption of rarely consumed foods. Data from FFQ or FPQ were, however, not transmitted to EFSA.

Administration of the interview

The vast majority of surveys in the Comprehensive Database used the face-to-face interview method, mainly at the respondent's home. There were also two surveys conducting 24-h dietary recalls by telephone (Germany and the Netherlands), while in Austria one self-administered 24-h dietary recall was collected via postal mail. Numerous studies (Derr et al. 1992; Lyu et al. 1998; Casey et al. 1999; Tran et al. 2000; Bogle et al. 2001) concluded that the telephone 24-h dietary recall interview method provides a reliable and cost-effective alternative to a face-to-face method, with similar response rates being observed for both methods, whereas there are not as many studies in the literature that have examined postal questionnaires as a method of obtaining dietary information. In general it seems that both face-to-face and telephone interviews are more suitable for collecting dietary and health data compared with postal questionnaires (Sibbaldi et al. 1994). The effect of the number of face-to-face meetings is likely to improve the accuracy of dietary estimates as the number of contacts with the study subjects increases and especially if conducted by personnel with a nutritional background.

The home visit is considered the most appropriate location to conduct dietary interviews since it offers the advantage of collecting additional information on foods consumed, such as brand level data and food packaging, and could allow for the direct weighing of some dietary items (De Henauw et al. 2002). On the other hand, other locations like medical centres are likely to offer better conditions for the collection of additional information, such as biological samples (Riboli and Kaaks 1997).

Dietary interviews should be ideally conducted by nutritionists or dieticians. In alternative adequately trained staff could be employed. In the Comprehensive Database over half the surveys were conducted by an interviewer with a nutritional background.

Sampling design

The Comprehensive Database includes data from the most recent national dietary surveys carried out in 20 European Union Member States. Some surveys (Estonia, Ireland, Spain and Sweden) started before 2000, thus limiting the accuracy of consumption estimates of dietary items recently introduced onto the market.

Sample representativeness is a crucial aspect for the evaluation of the food consumption data gathered in the Comprehensive Database. Representativeness is a qualitative parameter related to the sampling design of a dietary survey. Significant biases can arise from a survey sample that does not represent the population at the national level.

Sample units (individuals or households) were selected randomly in all dietary surveys, but differences in the sampling design are observed. Concerning the sampling frames used, national population registers, address registers, postcode address files, general population census, consumer panels and electoral lists (only for the adult population) can all be considered as optimal sampling frames as far as these lists are regularly updated and each subject within the national population register is likely to be selected. The national register of the general practitioners' practices used in Bulgaria seems to be a good sampling frame for children since, due to national legislation, all children must be listed there. In Italy the use of telephone books has the potential of introducing unwanted bias, as non-telephone households, telephone numbers issued after the publication of the telephone directory, and unlisted numbers will be automatically excluded. In Spain the use of universities, health centres and pharmacies to recruit subjects randomly is likely to constitute a potential source of bias. In Slovakia the study population cannot be considered representative of the general population since subjects were only selected among employees of confectionery and bakery manufactures.

On the other hand, the use of the household as a sampling unit seems to be a convenient choice since an interviewer could collect information from more subjects during the same visit. However, food consumption estimates are likely to be mutually dependent when subjects from the same household are interviewed, thus leading to a reduced variability in terms of dietary pattern observed. In France and the UK only one respondent per household was included in the study. The random selection of subjects from households sampled within the national household budget survey in Poland seems to offer a good choice since it allows comparability between the two sets of data. A cost reduction of the survey can be obtained by the use of a multistage sampling design where, for example, a random choice of cities, as primary units, of households, as secondary units, and finally individuals within households is adopted. This method can be combined with a stratification, for instance, on regions or rural/urban areas to reduce sampling bias because the part of the variability of the studied indicator explained by the strata is controlled (Cochran 1977). All surveys in the Comprehensive Database were stratified for gender and age groups with the exception of Austria. The number of subjects participating in the dietary survey varied sizeably from survey to survey. The adult population group (from 18 to 64 years of age) was the only represented age group in all 20 Member States with a number of study subjects varying from 400 (Slovenia) to 10,419 (Germany) where the study population was sampled at a very fine geographical level (Federal State level). A large sample

gives the opportunity to collect more information on rarely consumed foods.

The target population of a national dietary survey includes all people living in the country at the time of the study. However, institutionalised subjects, such as the elderly in retirement homes or people residing in hospitals, prisons or military barracks, have not been included in the large majority of dietary surveys. Their exclusion is often considered necessary to simplify sampling procedures, as outlined in the recommendation of the EGFCD (EFSA 2009) for a future pan-European dietary survey.

Despite pregnant and breastfeeding women being specifically excluded only in seven surveys, where included their number is overall rather low, i.e. from zero (Spain I) to 59 (Denmark) breastfeeding women and from zero (Spain II) to 52 (Germany) pregnant women. Therefore dietary estimates of these important subgroups should be treated cautiously.

One important aspect of food consumption data is their representativeness over the different seasons. Ideally, 24-h dietary recalls and dietary records should be collected uniformly over the four seasons. This was achieved in the majority of surveys in the Comprehensive Database, with the exception of Bulgaria I, Bulgaria II, Estonia, Finland, Hungary, Latvia, the Netherlands, Poland and Spain II where an uneven distribution of recording days over seasons was reported. This issue is particularly relevant when using food consumption data to assess exposure to hazardous chemicals mainly present in seasonal foods. In addition, it has been suggested that a proportionate collection of dietary estimates in week versus weekends should be adopted, at the population level, in the sampling phase (Lyhne et al. 2005). Weekends were particularly under-represented in Austria, Bulgaria and Slovakia and over-represented in Bulgaria II. The effects of uneven sampling fractions over days of the week are potentially relevant for foods that exhibit specific consumption patterns related to weekend consumption, e.g. alcoholic drinks.

It has been argued that the response rates of dietary surveys should be high enough to ensure that individual dietary estimates can be generalised to the general population, thus avoiding under-sampling of specific population subgroups. Response rates were relatively low in Hungary (27%), Spain II (28%), Italy (33%), Belgium (41%), the Netherlands (42%) and Germany (42% for the total study). The high response rate in Slovakia (96%) is likely due to the very convenient sampling frame used. No information was collected on the type of incentives for the study subjects. The use of incentives is a common method for increasing survey response but can also introduce bias in dietary estimates by inadvertently drawing individuals from selected population subgroups or by influencing respondents' responses (Singer and Kulka 2002).

Portion size estimation

Systematic bias and large random error may occur while quantifying foods and no gold standard exists for the estimation of portion size (Wrieden and Momen 2009). The use of different aids will depend on the survey methodology, target population (Foster et al. 2009) and level of accuracy required. Weighing is considered to be the most precise method for measuring food intake, however it is time-consuming, costly and disruptive (Wolper et al. 1995). It was used, alone or in combination with other methods, in the UK, Ireland and Spain only. As an alternative to weighing all food items eaten, consumption can be measured based on the subjects' estimates of portion size. The parallel use of different portion size measurement aids (PSMAs), such as photographs, household measures, rulers, etc., was considered the most convenient option by the EGFCD (EFSA 2009) in order to obtain best estimates for different foods. Indeed the majority of surveys (in 19) used a combination of two or more measurement tools, with 16 using the picture book as one of the tools and all but four of these used a validated or tested picture book. Measuring children's dietary intake is challenging. Foster et al. (2009) investigated whether the estimate of portion sizes for children would improve if they were provided with age-appropriate tools. They concluded that providing children with food photographs depicting age-appropriate portion sizes increased the accuracy of estimates compared with estimates using photographs designed for use with adults. The EGFCD also stressed the importance of using age-appropriate tools and portion size aids which are representative of the food available on the market and of the food portions actually consumed. Six of the 22 surveys included children less than 10 years of age. Bulgaria II, Denmark and Italy reported the use of the same picture book as for the adults but with special sets of smaller portion sizes for children.

It might be advisable to examine more closely estimated food portion quantities in those surveys' data using only household measurement tools (Austria), household measurement tools in combination with packaging size (Spain II) and, in particular, in those two countries reporting no use of any PSMAs to quantify portion sizes. This latest case is related to the dietary surveys carried out in Slovakia, where the interviewer estimated portions relying only on the subject's description, and in Hungary where 'reference tables' were used by all study subjects.

Dietary software and database

Different software (and associated databases) for the collection and/or processing of food consumption data were used in the 22 surveys, thus introducing extra

complexity for the comparability of dietary information across surveys. Only three surveys (Belgium, Germany and the Netherlands) used the EPIC-SOFT program (Slimani et al. 1999), thus making these three surveys more comparable.

Cautious interpretation of consumption data is advisable in almost half of the surveys which did not use yield factors to disaggregate composite foods from cooked into their raw ingredients. Hence, the cooked foods are considered as consumed as such and consumption estimates of these particular food groups might differ from those in countries where yield factors were used to disaggregate the recipes into the ingredients as purchased. Overestimation of exposure might result from these surveys in certain foods such as pasta or rice (the cooked weight of one portion is far higher than its raw weight), whereas underestimation may result in other foods such as meat or fish (their weight decreases when cooked since they lose water). In Sweden recipes were not disaggregated into ingredients. As a result an underestimation of the foods used regularly as ingredients in recipes, e.g. cheese or tomato, can be expected in the Swedish data.

For some exposure assessments within the focus of EFSA, additional information to the food name might be needed. For example, the concentration of heat-generated food toxicants, food additives and substances migrating from packaging materials in foods can differ by household processing method, by brand names, or kind of packaging, respectively. It was requested that national data providers provide available information on brand, household processing and packaging, additionally to the food name information. The available information on brand was very limited at country level. Concerning the information on household processing, in about two-thirds of surveys different information on household processing for varying percentages of food records was collected. Information on baking, frying and grilling of food was available in the vast majority of the surveys where household processing information was collected. Information on packaging material was only available in Belgium (24% of food records), Germany (5%) and Spain II (1%), and its use for exposure assessment purpose is likely to be very limited.

Available brand and household processing information might differ throughout the surveys since different survey objectives might result in the collection of different information on the foods consumed. Similar to the brand names, information on household processing is sometimes only available as a part of the food description, instead of as a separate variable, and this cannot easily be extracted. It should be noted that for the brand names, and partly also for the packaging information, the level of detail related to all food items might not be sufficient for a complete exposure assessment. If brand-level information is available, it will further need to be linked to chemical occurrence data specific for that branded food (e.g. food additives). The use of this information for exposure assessment must be decided case by case, based on the availability of information for the food categories of interest.

Information on brand name, food packaging and household processing is available for some of the countries that have used 24-h recall as well as for some countries that have used food records. This confirmed that this information can be collected by both protocols. However, the three surveys using 24-h dietary recall by means of the EPIC-SOFT program provided a higher number of different descriptors of household-processing information.

In summary, the use of brand information is limited to certain foods and only available in a restricted number of surveys; information on household processing might be useful in a larger number of countries whereas the available packaging information appears to be of poor use for exposure assessment. In this respect, the EGFCD (EFSA 2009) recommended the collection of information on brand name, physical characteristics of the packaging and household cooking procedures. However, other data sources, like market share data from marketing research studies, could be linked to the food consumption data in order to fill the information gap for exposure assessments.

Under-reporting

Under-reporting was assessed in a number, but not all, surveys by a comparison of individual energy intake estimates with Goldberg cut-off points. In the evaluated surveys a varying proportion of under-reporters was identified, i.e. between 12% and 37%. It was assessed that the Goldberg's cut-offs have moderately low sensitivity in identifying under-reporters (Black 2000b), thus suggesting that, although most study participants identified as extreme under-reporters are likely to have truly underestimated energy intake, a proportion of study subjects identified as normal reporters are likely to be under-reporters. One effective way to improve the identification of under-reporters is to use complementary information on individuals' physical activity levels. This strategy was followed in France, where the cut-off points were corrected on the basis of physical activity levels (Black 2000b). However, this approach finds a natural limitation in the fact that the assessments of physical activity are also prone to measurement errors (Ferrari et al. 2007).

In the guidance document of the EGFCD (EFSA 2009) it was suggested that individual measurements should not be excluded on the basis of estimated under- or over-reporting assessed with short-term dietary assessment methods. Rather, dietary

measurements considered unreliable by the interviewers should be removed from the database.

The inclusion in the database of surveys with a high frequency of under-reporters may lead to an underestimation of mean dietary exposure and of the percentage of consumers of some particular foods, e.g. foods with high fat or sugar content, whose estimation is more prone to under-reporting (Becker et al. 1999). On the other hand, under-reporting is likely to have less impact on the assessment of high percentiles of consumption.

An extensive review from Gorber et al. (2007), evaluating the relationship between self-reported and directly measured height and weight, showed trends of under-reporting for weight (ranging from −0.1 to −6.5 kg in women and from −0.1 to −3.2 kg in men) and over-reporting for height (ranging from 0.6 to 7.5 cm). A slight over-estimation of exposure expressed per kg body weight is therefore expected when using data from the 13 dietary surveys that collected the weight information through self-reporting.

Uncertainty analysis

The uncertainty related to exposure estimates based on the Comprehensive Database is presented and discussed for a number of methodological parameters characterising each dietary survey. It has been highlighted that different survey methodologies have the potential to induce uncertainties on exposure, especially for the comparison of results between countries. Although in some circumstances the effect and direction of potential bias in exposure estimates can be, to a certain extent, anticipated, this is not consistently possible. For example, it is recognised that estimating high percentiles of habitual consumption, when only one record or recall day is available per subject, leads to the overestimation of intake. In dietary surveys the degree of such overestimation is often an unknown quantity in the absence of accurate information on the true variability of a given food. Similarly, the effect of a non-random selection of survey participants might be difficult to predict in magnitude and direction. The effects of an uneven sampling over days of the week can be, for example, particularly relevant for the consumption of alcoholic drinks and not for bread, whereas the reported consumption of soft drinks and certain types of fruits and vegetables can be significantly affected if the survey design does not capture consumption patterns evenly across the seasons. With these examples it is intended to stress the fact that uncertainty is likely to be specific (1) to food or food groups, (2) to the characteristic of population in terms of dietary habits, and possibly (3) to subgroups within a population.

Existing guidance documents on uncertainty refer to the uncertainty in exposure assessment (EFSA 2006; World Health Organization (WHO) 2008) but not to uncertainty of data inputs. Because the uncertainty of a database can be evaluated only by considering the objective of the assessment, it is therefore deemed extremely difficult to anticipate quantitatively an overall level of uncertainty for each dietary survey. The description of the surveys given in the present paper will enable the risk assessor to perform a qualitative uncertainty analysis and, to a limited extent, also a quantitative analysis when using the Comprehensive Database to assess exposure. The qualitative evaluation of uncertainty represents a valuable option by considering, if possible, the effect of a given parameter on the estimation of the consumption of specific food or food groups. This qualitative approach is in accordance with an EFSA guidance related to uncertainty in dietary exposure assessment (EFSA 2006). Nevertheless it is recognized that in some circumstances qualitative evaluations can be complemented by methods for quantitative uncertainty analysis of inputs to models for exposure, such as intervals and probability bounds, fuzzy methods, probabilistic methods and sensitivity analysis, as recently summarised by WHO (2008). These methods, requiring careful consideration, could be used to evaluate the uncertainty related to specific methodological parameters characterising the Comprehensive Database.

Conclusions

The food consumption data gathered at EFSA to be part of the Comprehensive European Food Consumption Database offers a unique resource for risk-assessment activities routinely carried out by EFSA. However, dietary data collected at the national level cannot be directly compared due to the different study designs, methodologies and protocols adopted in different Member States. In particular, differences exist with respect to a number of parameters affecting the level of detail and the accuracy of the collected data, such as the dietary assessment method used, the description and codification of the food consumed, number of days per subject, sampling design, the quantification of portion sizes, software applications used, and the non-dietary information collected. Furthermore, in three countries data provided to EFSA came from national dietary surveys carried out more than 10 years ago.

The collection of accurate food consumption data at a European level following a harmonized methodology and protocols is a primary long-term objective for EFSA, and it has been recognised as a top priority for collaboration with European Union Member States.

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