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Content

Preface

The NORDIRA project started in 2009 by setting an expert group to collect experiences of applications of dietary surveys in the Nordic countries. Their expertise covered both dietary surveys and food-based risk assessment. The NORDIRA project aimed to serve as a platform for capacity building in the fields of dietary survey methods as well as food safety-related risk assessment methods. The experts represented national research institutes and universities from all the five Nordic countries.

The NORDIRA project collected information on study settings, methodology and reporting in national dietary surveys such as Danskernes kostvaner, FINDIET, The diet of Icelanders, UNGKOST and NORKOST and Riksmaten. The NORDIRA project group disseminates the results in this TemaNord report and discusses methodological aspects and the application of the national food consumption data in risk assessment, with a particular focus on the harmonization needed for the between-country comparison of food consumption, nutrient intakes and contaminants.

The NORDIRA group collected experiences in food-based risk assessments drawing on national food consumption data. The framework of risk assessment also includes experiences and developments in this field at the European level. The average food consumption data at the European level might ignore some local features in data management. An overview of food-based risk assessment studies in the Nordic countries is presented. This Nordic cooperation may provide new perspectives on food safety discussion.

Co-operation within the Nordic countries may emphasize aspects that are not covered by the pan-European data structure. It is valuable to share experiences in methodologies used to collect dietary data and report food consumption and nutrient intake as well as carry out risk assessments of harmful substances in food. This report presents the views of Nordic experts on the development of risk assessment in the field of food safety.

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List of definition of nutrients and list of abbreviations

- AOAC, Association of Official Analytical Chemists
- E% = percent from daily energy
- FFQ = Food frequency questionnaire
- kJ = 0.239 kcal
- kcal = 4.184 kJ
- MJ = energy kJ/1000
- Energy in KJ calculated by conversion factors from protein (17 kJ/g), carbohydrate (17 kJ/g), fat (37 kJ/g) and alcohol (29 kJ/g)
- Energy in kcal calculated by conversion factors from protein (4 kJ/g), carbohydrate (4 kJ/g), fat (9 kJ/g) and alcohol (7 kJ/g) or from energy in kJ (1 kcal = 4.184 kJ)
- Fat = total lipid g
- SFA = Saturated fatty acids g
- Sugar = Mono- and disaccharides g
- Fibre = total dietary fibre determined gravimetrically or by AOAC total dietary fibre method or by summing non-starch polysaccharide components and lignin
- Vitamin C = Ascorbic acid and ascorbate mg
- Vitamin E = Alpha-tocopherol mg
- Vitamin D = Ergocalciferol and cholecalciferol µg (1 µg = 40 IU)
- DTU Danish Technical University
- NFA National Food Agency
- THL National Institute for Health and Welfare

Summary

The NORDIRA project aimed to provide a network for Nordic experts on dietary surveys and food-based risk assessment. The group consisted of experts in these themes from all five Nordic countries. The project held three meetings in order to present current results and methodological aspects of national dietary surveys. All Nordic countries have carried out national dietary surveys and most of these countries have data for all age groups. All countries had experience in how food consumption data is used in the assessment of the risks of harmful chemical substances.

The themes of the work within NORDIRA group included data collection experiences, food consumption and nutrient intake results, application of food consumption data in risk assessment and calculation processes in risk assessment. The experts represented the following research and administrative institutes: Danish Technical University DTU (Denmark), The National Institute for Health and Welfare THL and The National Food Authority EVIRA (Finland), University of Iceland and the Icelandic Food and Veterinary Authority (Iceland), University of Oslo and Norwegian Scientific Committee for Food Safety VKM (Norway), National Food Administration NFA(Sweden).

The group of experts collected information and figures concerning Nordic dietary surveys, the dietary methods used, the coverage of surveys in different age groups, and participation rates. Basic food consumption is compared between Nordic countries in accordance with the food classifications used in national reports. In this report nutrient intakes are also summarized and some examples of nutrient intake distributions are presented. The NORDIRA-group aimed to collect more in-depth food consumption data for a number of food groups that were selected according to dietary guidelines. This task was completed in Denmark and Finland. Analyses of the distribution of nutrient intakes were completed also in Denmark and Finland.

Applications of food consumption data in food-based risk assessments were presented in the yearly meetings of the NORDIRA-group. Several cases in exposure to chemical substances were presented, from which cases intake estimations for caffeine, sweeteners, food preservatives, pesticides, methylmercury, perfluorinated compound, dioxins, cadmium and heterocyclic amines are presented in this report.

This TemaNord Report is a summary of the presentations and experiences shared during the three year period of the NORDIRA project. The group emphasizes a flexible food aggregation system in reporting food consumption to enable different kinds of matching of data on consumption and occurrence of chemical substances. The application of food consumption data in exposure assessment is sensitive to identification and comparability of food descriptors and often case-specific.

1. Introduction

National dietary habits and nutrient intakes have been the target of nutritional studies in the Nordic countries for decades. Dietary surveys provide information about individuals' food consumption and dietary habits. Food consumption is converted to nutrient intakes by using calculation procedures and national food composition databases. National dietary surveys produce data on average daily food consumption, the proportion of consumers of selected food items, and nutrient intake as well as distribution estimates of intakes in population groups. The intake estimates give valuable information for studying the adequacy of nutrient intakes based on the averaged values in a population.

National dietary surveys can assess the dietary habits of populations, they can reveal common nutritional problems and thus also potential health problems. Dietary surveys have been used for formulating nutrition recommendations and evaluating the compliance of dietary recommendations at a national and international level (Nordic Council of Ministers 2004).

Dietary surveys can be conducted by different dietary assessment methods: Food diaries are used for recording eating events and food consumption prospectively, while retrospective methods include food recalls, which collect information on the food intake of the previous day, and frequency methods, which estimate the frequencies of food consumption during the last month or year.

Nordic countries have worked to standardize dietary methodology (Hagman et al. 1990) including the estimation of food portion sizes (Haraldsdóttir et al. 1998). Lately, the harmonization of dietary methods has been in the focus of European nutritionists and food scientists. Also, the European Food Safety Authority (EFSA) aims to harmonize methodologies and in 2009 issued guidance for the collection of national food consumption data (EFSA 2009). EFSA evaluated the food classification system used in the collected data (EFSA 2011b). Danish, Finnish and Swedish food consumption data can be extracted from EFSA's database. Dietary surveys provide data for food-based risk assessment with regard to chemical hazards or vitamin intake overdoses. Harmonized methods in data collection and data presentation are emphasized nationally and at the European level.

The European Food Consumption Validation (EFCOSUM) Project was devoted to the development and validation of a standardized method for food consumption surveys, evaluating the intake of foods, nutrients and potentially hazardous chemicals in the European population (De Boer et al. 2011, Crispim et al. 2011). The findings of the EFCOSUM Project provide sufficient evidence to conclude that a repeated 24 h dietary recall using EPIC-soft for standardization, in combination with a food propensity questionnaire and modelling of usual intake, is a suitable method for pan-European surveillance of nutritional adequacy and food safety among healthy adults and potentially in children aged 7 years or older.

Some studies comparing Nordic dietary habits are available (Becker et al. 2001, Similä et al. 2003, NCM 2006, Prättälä et al. 2009). It has been noticed that the trends in dietary habits in the Nordic countries have been quite aligned, and nowadays habits in the different countries resemble each other in many ways. Similarities are seen particularly when comparing the Nordic countries with other parts of Europe.

The NORDIRA project was started in order to share knowledge and experience in dietary surveys and the use of dietary data in risk assessment. Regional harmonization of dietary data collection and general guidelines for the presentation of results are in the common interest. This cooperation may improve study settings as well as the presentation and comparability of the results. This report aims to compare the design, implementation and results of dietary surveys that are conducted in the Nordic countries. Methodological aspects concerning nutritional evaluation and the use of the dietary data in risk assessment are also included.

This report summarizes study settings in Nordic dietary surveys and the main results in food consumption and nutrient intakes, and presents some examples of food consumption in specific food groups. The application of food consumption data in risk assessment is presented with country cases. The discussion section summarizes the experiences.

2. Food consumption and food habits in the Nordic countries

2.1 Food consumption per capita

For risk assessment purposes, it is sometimes useful to use per capita food consumption data. This may be relevant in order to measure the maximum possible intake of nutrients from raw agricultural products. The annual national per capita figures for food consumption in the major food groups have been published in Food Balance Sheets (FAO 2012). The statistics present annual food production and food availability for human consumption. Per capita consumption can be used as such or in combination with individual consumption data.

The data from all five Nordic countries – Denmark, Finland, Iceland, Norway and Sweden – during the period from 1965–1998 has been compared (Becker et al. 2001). Food availability is relatively similar for major food groups like milk and dairy products and margarine, meat and meat products, sugar, eggs and cereals (Becker et al. 2001). On the contrary, some data are not as comparable due to e.g. differences in data sources, conversion factors and commodity coverage. These foods include fish and fish products, oils, potatoes, fruit and vegetables.

Some differences in dietary habits have been noticed (Becker et al. 2001). During almost the entire period, the consumption of cereals was highest in Finland. Sugar, which includes honey and syrup, has been consumed most commonly in Iceland. Consumption of milk on the whole has been quite constant in all countries (highest consumption in Iceland and Finland), but the fat intake from milk has decreased as the consumption of low-fat and fat-free milk (<2% of fat) has increased constantly in all countries. However, the consumption of low-fat milk saw the most dramatic increase in Finland in the 1970s and remained higher than in the other countries. Consumption of meat has increased in all of the countries, but the greatest growth has been seen in Denmark. Some common trends in food consumption development are clearly seen in all countries: the consumption of butter and margarines has decreased but the consumption of cheese, fruits and vegetables has increased.

2.2 Dietary habits in the Nordic countries

Health behaviour and lifestyle habits have been studied by looking at indicative food choices. National studies were compared for the Nordic monitoring of diet, physical activity and overweight; these studies included approximately 13 questions on food choices (Fagt et al. 2009).
The *NORBAGREEN* Study (Similä et al. 2003) was started in the year 2001 to examine the consumption of indicative foods related to healthy food habits in the Nordic and Baltic countries. In the earlier NORDGRÖNT project (Johansson et al. 1999) it was noticed that vegetable and fruit consumption statistics were not comparable across the Nordic countries. As a result of this, a validated questionnaire covering the frequency of consumption of 51 food items was developed. This questionnaire, NORBAGREEN FFQ, was validated in two countries (Petkeviciene et al. 2009).

The main results of the NORBAGREEN study when looking only at the Nordic countries were as follows. The mean consumption frequency of vegetables was highest in Sweden and in Finland; for potatoes it was highest in Iceland and Finland. The proportion of low fruit consumers – i.e. those who ate fruit less than once a week – was higher in men than in women. Consumers in Finland ate the most berries.

Bread was eaten most frequently in Finland and in Norway, and was consumed least frequently in Iceland. In most of the countries, bread high in fibre (> 6g/100g) was the most popular choice (Similä et al. 2003). When the NORBAGREEN results were compared to dietary guidelines, it was found that less than 15% of respondents consumed vegetables and fruit as recommended, i.e. five times a day or more (in total).

The Nordic Council of Ministers compared food habits and physical activity in the Nordic countries and concluded that they fall far short of the official recommendations (NCM 2006). Cooperation on health, food and physical activity was planned with a view to decreasing the prevalence of overweight and obesity among both adults and children. The experts estimated that the intake of fat and saturated fat is too high and the intake of fruit and vegetables is too low. The average intake of sugar in the population corresponds to the recommended maximum, which means that many persons consume more sugar than recommended. However, the range of dietary intakes is considerable and the mean intake values cover very low and very high intake values. It is noted that the available data were collected in different years and with different methods; therefore, they should only be interpreted and compared carefully and regarded critically. This report also emphasizes that it is important to have

common methods to ensure the comparability of the results between countries.

Vegetable consumption and its associations with education were studied in European countries (Prättälä et al. 2009, Roos et al. 2000). Especially in the Nordic countries, higher educated individuals ate more vegetables than other people. Unlike in the Mediterranean countries, people in the Nordic countries do not eat vegetables on a daily basis; the reasons for this may include seasonal availability and high prices.

Similarities in the dietary habits of the Nordic countries can be seen especially when comparing them to other European countries. The *EPIC study* revealed that there are three main region-specific patterns in Europe (Freisling et al. 2010). In Mediterranean regions the nutrient patterns were dominated by relatively high intakes of vitamin E and MUFA, whereas intakes of retinol and vitamin D were relatively low. In contrast, in the Nordic countries, the reported intakes of these same nutrients resulted in almost opposite patterns. The diet in the Nordic countries is characterized by a higher consumption of animal, processed, and sweetened foods, including non-alcoholic beverages and soft drinks. Added fats, spreads and dairy products – which are frequently fortified with retinol and vitamin D – are also common. The third pattern included high intakes of PUFA and SFA, but low intakes of MUFA in combination with a relatively high intake of sugar. Because of this, the specific areas also share similar nutritional problems, which in the Nordic countries seem to be a high intake of SFA and excess consumption of sugared food and beverages.

It is apparent that the Nordic countries have similarities in dietary habits. This is partly due to their geographic location, but cultural similarities might also play a role. In spite of the fact that not all the results are comparable between countries due to factors such as variation in data collection methods, the consumption and intake trends can still be studied. Dietary similarities are highlighted when the Nordic countries are compared to the rest of the European countries. The Nordic countries have also cooperated to develop a catalogue for best practices in the promotion of healthy lifestyles (Berg Christensen et al. 2011). This project is developing indicators and a harmonized protocol for the collection of data on dietary habits and physical activity in all the Nordic countries. So far, dietary surveys have seldom been compared in the Nordic countries.

3. Dietary surveys in the Nordic countries in the 2000s

3.1 Study design and participation

The NORDIRA project used a questionnaire (Appendix 1) to collect information on national dietary surveys. The results of this questionnaire are presented in Tables 1–3. In addition, the published results from each country are presented in this chapter and in the appendices. The status of national dietary surveys was the starting point for discussion on methodology and its later use for various purposes.

For the actual estimation of nutrient intakes, food consumption data needs to be examined at the level of individuals. Dietary methods have been developed for this purpose. The general aim of the national dietary survey is to describe and quantify food consumption at individual level (Willett 1998). Food and nutrition surveys have been carried out in the Nordic countries both by universities and by research institutes (Table 1). Dietary surveys have been completed among both children and adults.

Ideally, the sampling should be country representative, which seems to be feasible in most Nordic countries. However, if a dietary survey is conducted together with a health survey, other sampling protocols, e.g. regional sampling, may be used, as is the case in Finland. Dietary surveys since 2000 are presented in Table 1. The table also includes the latest data collections although none of their results are presented in this report.

Table 1. Summary of the Nordic dietary surveys in the 2000s.

Country	Institution[1]	Name of the survey	Year of the data collection	Country coverage
Denmark	National Food Institute	Danskernes kostvaner 2003-2008,	2005–2008	Country representative
			2010-	
Finland	National Institute for Health and Welfare (THL)	FINDIET	2002, 2007 2012	5 regions
		The Diet of Finnish Preschoolers	2003–2005	2 regions
		The diet and well-being of secondary school pupils	2007–2008	3 regions
Iceland	University of Iceland	The Diet of Icelanders	2002	Random sample
Norway	University of Oslo	UNGKOST-2000	2000–2001	Country representative
		NORKOST 3	2010–2011	
	Norwegian Food Safety Authority and	The Norwegian Fish and Game study part B	2000	27 coastal and inland municipalities
	Norwegian Institute of Public health	The Norwegian Fish and Game study part C	2003	Selected participants from part B. Consumers with presumed high intake of contaminants and a reference group.
Sweden	National Food Administration (NFA)	Riksmaten – barn 2003	2003	Country representative
		Riksmaten 2010	2010	

[1] Websites of the institutes: www.food.dtu.dk, www.thl.fi, www.landlaeknir.is www.helsedirektoratet.no, www.slv.se

The National Food Institute (Denmark, DK), National Institute for Health and Welfare (Finland, FI), National Food Agency (Sweden, SE), University of Oslo (Norway, NO) and Ministry of Health in collaboration with the University of Iceland and the Icelandic Food and Veterinary Authority (Iceland, IS) are the institutes that have carried out the latest national dietary surveys. The samples varied from 400 inhabitants to 5,000 inhabitants (Table 2). The participation rate in the surveys has varied from 53% to 83% of the invited persons. In Finnish surveys, height and weight are measured as part of a health examination. In Denmark, Norway and Sweden height and weight are self-reported.

Several dietary assessment methods are available (Willett 1998) and many of them are also used in the Nordic countries (Table 2). The selection of dietary assessment method is dependent on the focus of the nutrition study; in national surveys, the first aim is to obtain the average intake estimates. EFSA has concluded that a repeated 24-hour dietary recall is a suitable method for food consumption data for risk assessment purposes.

Table 2. Information on the participants in the dietary surveys in the years 2000–2008

Country	Name of the survey	Age range	Persons	Response rate (%)	Height, weight
Denmark	Danskernes kostvaner 2003–2008	4 – 75 y	4431	53	Self-reported
Finland	FINDIET	25– 74 y	1576	63	Measured
	The Diet of Finnish Preschoolers	1– 6 y	2535		Measured
	The diet and well-being of secondary school pupils	7th and 8th graders	659	52	Measured
Island	The Diet of Icelanders 2002	15 – 79 y	1399	70	–
Norway	UNGKOST-2000	4 y	391	58	Self-reported
		9 and 13 y	1815	83	
Sweden	Riksmaten – barn 2003, Livsmedels- och näringsintag bland barn i Sverige	4 y, 2nd and 5th graders	2495	74	Self-reported

Further dietary surveys aim to calculate the nutrient intake of each subject by converting food consumption into energy and nutrient intakes. To this end, national food composition data is processed using calculation software. Nutrient definitions in the databases may vary due to differences in the analytical and methodological background of each country. Each Nordic country has a national food composition database with data on the nutrient values of each national food (Table 3). For composite foods the nutrient values are produced by recipe calculation options (Becker et al. 2002).

The report from the Danish national dietary survey covers a long time period (2003–2008) and a wide age range from 4 to 75 years (Pedersen et al. 2010; Table 2). Finland has carried out a national dietary survey – FINDIET – that only covered adults (Paturi et al. 2008) and two dietary surveys with different age groups of children in a local study setting (Hoppu et al. 2008, Kyttälä et al. 2008). The national dietary survey of Icelanders covered individuals aged over 15 years (Steingrimsdottir et al. 2002). Norway has one dietary survey on three different age groups of children, which was carried out at the beginning of the 2000s (Pollestad et al. 2002, Øverby & Frost Andersen 2002). Sweden carried out the dietary survey RIKSMATEN in children of different ages (Enghardt Barbieri et al. 2006). Denmark, Iceland, Norway and Sweden started new national dietary surveys in 2010.

3.2 Dietary methods applied in Nordic dietary surveys

Food diaries, 24-hour diet recalls and food frequency questionnaires were used as dietary methods (Table 3). Food diaries have been used for children in Finland, Norway and Sweden while a semi-structured 7-d food diary has been used for children in Denmark. The Norwegian pre-coded food diary features a list of 277 food items, which is supplemented with open-ended alternatives. Among adults in NORKOST 3, the dietary assessment method was two 24-h recalls on non-consecutive days, and in addition a food propensity questionnaire. For adult Swedes, a newly developed web-based four-day record – Riksmaten 2010-11 – was used together with a questionnaire on physical activity, education and specific foods.

Table 3. Summary of dietary methods and tools in the Nordic dietary surveys

Country	Name of the survey	Dietary method	Food composition database	Checking in the interview or entering data
Denmark	Danskernes kostvaner 2003–2008	7-d food diary semi-structured	Foodcomp.dk	Outliers of food and energy checked
Finland	FINDIET	48-h dietary recall[1]	Fineli, www.fineli.fi	Energy checked
	The Diet of Finnish Preschoolers	3-d food diary		
	The diet and well-being of secondary school pupils	48-h dietary recall[1]		
Island	The Diet of Icelanders 2002	24-h diet recall by telephone[2]	ISGEM	–
Norway	UNGKOST-2000	Pre-coded food diary	KBS (University of Oslo)	Scanning of pre-coded food diary
	Norkost 3	2 x 24-h recall		
Sweden	Riksmaten – barn 2003, Livsmedels- och näringsintag bland barn i Sverige	4-d food diary	Livsmedel databasen www.slv.se	–
	Riksmaten 2010–11	4-d web-based diary		Outliers of food and energy checked

[1] Computer-assisted interview

[2] Repeated 24-h recall was used in the most recent dietary survey in Iceland 2010–2011

The 24-h diet recall was repeated on two consecutive days and was used in FINDIET by means of a computer-assisted interview design. On the other hand, the 24-h dietary recall interviews were conducted and completed by telephone in Iceland in 2002. A pre-coded 7-day food diary was used in Denmark. In the Norwegian EPIC study, dietary interviews by telephone were compared with face-to-face interviews and were found to be comparable (Brustad et al. 2003).

In order to facilitate the quantitative estimation of food consumption, photos and pictures of portion sizes and picture booklets are used in dietary surveys in all the Nordic countries (Table 4). Some examples of pictures of food portions are presented in Appendix 7. The number of food portions of different sizes shown in the booklets varied from three to six. In addition, household measures and package volumes are used for the assessment of the amounts eaten.

Table 4. Picture booklets used for portion size estimation in the Nordic countries

	Country	Picture booklet	Illustrations or photos	The average number of portion sizes	Other
The Danish National Survey of Dietary Habits and Physical Activity	DK	Yes	Real	6	Household measures
Portion size book of foods (Ruokien annoskuvakirja)	FI	Yes	Real	3	Portion size lists, Household measures
The Diet of Icelanders	IS	Yes		4	Household measures
Kosthold bland 4-åringer / UNGKOST-2000 Norkost 3	NO	Yes	Both	4	–
Matmallen (Livsmedelsverket 1997) / Portionguide 2010	SE	Yes	Both Real	5 6	Household measures

3.3 Food consumption of children and adults in the Nordic countries

Preschool children

Food consumption data was available for children within a similar age range in Denmark, Finland, Norway and Sweden. Milk, bread and cereal products were the main food items in the diet of preschool children in the Nordic countries (Table 5). The consumption of main food groups showed no remarkable differences among children between the Nordic countries. Bread, cereals and potatoes were consumed most commonly in Sweden, but at least 158 g/day of bread and cereals and at least 34 g/day of potatoes were consumed in the other countries.

The consumption of vegetables and beverages was clearly highest among Danish children, who were also the eldest (Table 5, figure 1). Almost the same amounts of fruits and berries were consumed in all countries (range from 149 to 197 g/day), Finland being the country

where the consumption was the lowest. Fish was eaten in low amounts and least commonly among Finnish children.

Sugar consumption was very similar in all countries, around 44–55 g/day. However, a definition of sugar is not clear: Does sugar include only added sugar? Or is sugar the sum of all mono- and disaccharides from natural and added sources? Is sugar consumption calculated as reported added sugar or after splitting dishes which contain sugar ingredients into ingredient sugar? So, there may be differences in the way to measure sugar consumption. Danish and Norwegian surveys measured only added sugar while Finnish and Swedish surveys measured sucrose, including both natural and added sugars. The Icelandic study has also separated out added sugar from the total sugar intake (Þorgeirsdóttir et al 2012).

Table 5. Food consumption (g/d) of selected food groups among children

		Milk[5]	Bread, cereals	Potato	Roots, vegetables	Fruits, berries[6]	Fish	Sugar	Beverages[7]
DK (2003–2008) 4–5-y-olds[1]	Girls (78)	488	170	45	117	173	12	48	524
	Boys (81)	509	193	57	113	197	13	51	631
FI (2003–2004) 4-y-olds[2]	Girls (247)	465	231	71	56	151	10	44	539
	Boys (307)	467	253	79	55	149	9	47	583
NO (2000) 4-y-olds[3]	Girls (206)	384	158	35	59	175	25	55	406
	Boys (185)	398	175	34	51	163	28	55	404
SE (2003) 4-y-olds[4]	Girls (288)	367	249	75	49	173	15	49	314
	Boys (302)	418	273	82	46	182	18	53	337

[1] Danskernes kostvaner 2003–2008

[2] The Diet of Finnish Preschoolers (DIPP), 2003–2004

[3] UNGKOST-2000

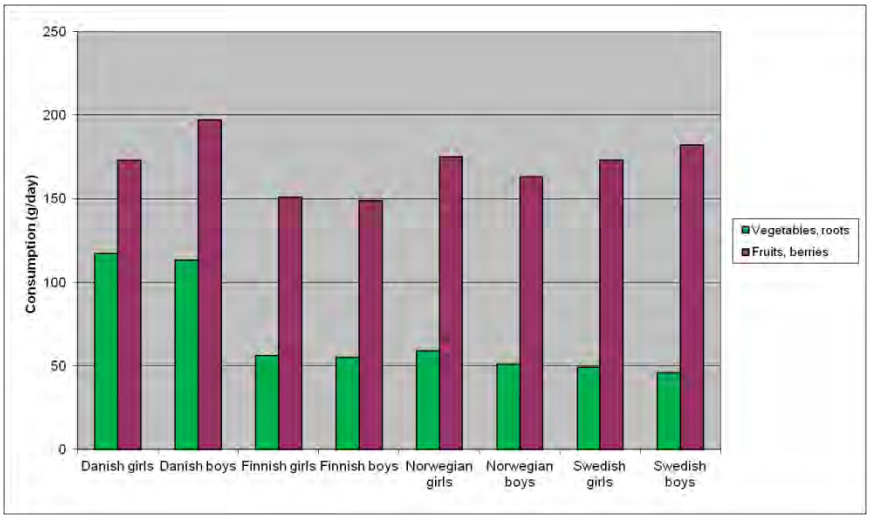
[4] Riksmaten – barn 2003, Livsmedels- och näringsintag bland barn i Sverige

[5] Liquid milk products

[6] Nectar and juice are included in the group of fruit and berries in all countries.

[7] Beverages include all beverages apart from juice, nectar or milk.

Figure 1. Daily consumption of fruit, berries and vegetables among 4–5 years old Danish and 4-years old Finnish, Norwegian and Swedish children. The consumption data was collected during 2003–2008 in Denmark, 2003–2004 in Finland, in 2000 in Norway and in 2003 in Sweden.



Studies in adults

Adults also had similarities in their food habits in Denmark, Finland and Iceland in the 2000s (Table 6). Milk and milk product consumption amounted to over 300 g/day in all countries but was the highest among men in Iceland. Men also had the highest intake of added sugar, over 50 g/day in all countries. The consumption of bread and cereals was over 180 g/day in every country, and was the highest among Finnish men. Total vegetable consumption was quite constant except that men in Finland consumed much less vegetables than consumers in other countries. Almost the same amounts of fruits and berries were consumed in all countries, but the consumption was highest among Danish women. Icelandic men consumed twice as much fish as Danish people, whose consumption averaged 20 g/day. At least 1,400 g/day of beverages were consumed in all of the countries, but the Danes seem to have the highest consumption.

Table 6. Food consumption (g/d) of selected food groups among adults

		Milk[4]	Bread, cereals	Potato	Roots, vegetables	Fruit, berries[5]	Sugar	Fish	Beverages[6]
DK[1]	Women (1,785)	306	187	78	172	311	43	20	2,186
	Men (1,569)	341	245	127	150	251	55	23	2,317
FI[2]	Women (846)	318	287	58	161	263	43	37	1,574
	Men (730)	396	369	91	116	222	53	43	1,660
IS[3]	Women	325	254	69	195	237	49	31	1,491
	Men	460	244	102	202	225	76	51	1,508

[1] Danskernes kostvaner 2003–2008 (18–75-year-olds included)
[2] The National FINDIET 2007 (this table includes 25–64-year-olds)
[3] The Diet of Icelanders 2002
[4] Liquid milk products
[5] Nectarine and juice are included in the group of fruit and berries in all countries.
[6] Beverages include all beverages apart from juice, nectar or milk. Alcoholic beverages are included.

3.4 Food consumption data within EFSA's database

The European Food Safety Authority (EFSA 2011c) has created two food consumption databases from the existing national information. The EFSA Comprehensive European Food Consumption Database consists of the results from 32 dietary surveys. Competent organizations in the European Union Member States provided EFSA with data from the most recent national dietary surveys in their country, at the level of consumption by the individual consumer. This included food consumption data concerning infants, toddlers, children, adolescents, adults, the elderly and the very elderly.

The overview of the database (EFSA 2011) describes the coverage of age groups and exposure. For a common description of food consumption, a decision on a harmonized food classification is needed. Food classification is based on the biological similarity of the main ingredients. EFSA has proposed 20 main food groups in EFSA classification FoodEx (EFSA 2011b). The classification of bread is one of the complex issues in food classification. Issues include determining the main cereal ingredient and how often consumers are able to report the dominating cereal ingredient. Composite foods are prepared from a mixture of ingredients and EFSA is recommending the disaggregation of these foods and dishes into ingredients. For risk assessment at the European level, harmonized

food consumption data is essential and sufficient. Therefore the FoodEx classification is available and searchable on the web.

Main food categories in EFSA's classification are:

- Grains and grain-based products
- Vegetables and vegetable products
- Starchy roots or tubers and products thereof, sugar plants
- Legumes, nuts, oilseeds and spices
- Fruit and fruit products
- Meat and meat products
- Fish, seafood, amphibians, reptiles and invertebrates
- Milk and dairy products
- Eggs and egg products
- Sugar, confectionery and water-based sweet desserts
- Animal and vegetable fats and oils
- Fruit and vegetable juices and nectars
- Water and water-based beverages
- Coffee, cocoa, tea and infusions
- Alcoholic beverages
- Food products for young population
- Products for non-standard diets, food imitates and food supplements or fortifying agents
- Composite dishes
- Seasoning, sauces and condiments
- Additives, flavours, baking and processing aids

Some of the food categories are wide and specified and thus identification is easy in national dietary surveys. For example, fish and seafood is easily identified. However, complex food items occur on the food markets where ingredients are derived from various food categories. Also, in more detailed subgroups, products combining ingredient from vegetable oil and dairy fat such as butter-oil mixture may be difficult to classify. Therefore it is advisable to be aware of differences behind national food consumption data within EFSA's Comprehensive Database (Merten et al. 2011).

Only data collected through food records (15 dietary surveys), 24-hour dietary recalls (16 dietary surveys) and 48-hour dietary recalls (1 dietary survey) are included in the Comprehensive Database (EFSA 2011 c). The use of food consumption data from the Comprehensive Database at the individual level is restricted to EFSA but summary statistics are available to the public on the EFSA website. However, the use of

summary statistics from the Comprehensive Database is intended to produce conservative estimates of exposure.

The mean consumption of fish among children aged 3 to 9 in three Nordic countries is presented in Figure 2. The data is based on the EFSA Comprehensive European Food Consumption Database that contains data from Denmark, Finland and Sweden. The daily consumption of fish is highest among Swedish children and lowest among Finnish children.

In 2008 EFSA published the EFSA Concise European Food Consumption Database, which served as a starting point for the development of the EFSA Comprehensive European Food Consumption Database. The EFSA Concise Database gathered data on food consumption by adults in Europe and it is intended to provide a limited amount of data that will enable the easy performance of a conservative exposure assessment. The Concise Database contains data from all Nordic countries. Figures 3 and 4 present the mean consumption of fish and seafood among adults. Among all adults the consumption is most abundant in Norway where most adults consume fish. As only on 24-h recall was made in the dietary survey of Icelanders in 2002 the distribution of intake cannot be assessed.

Figure 2. Mean consumption (g/per day) of fish and seafood among children aged 3–9 years in the Nordic countries. (EFSA 2011a)

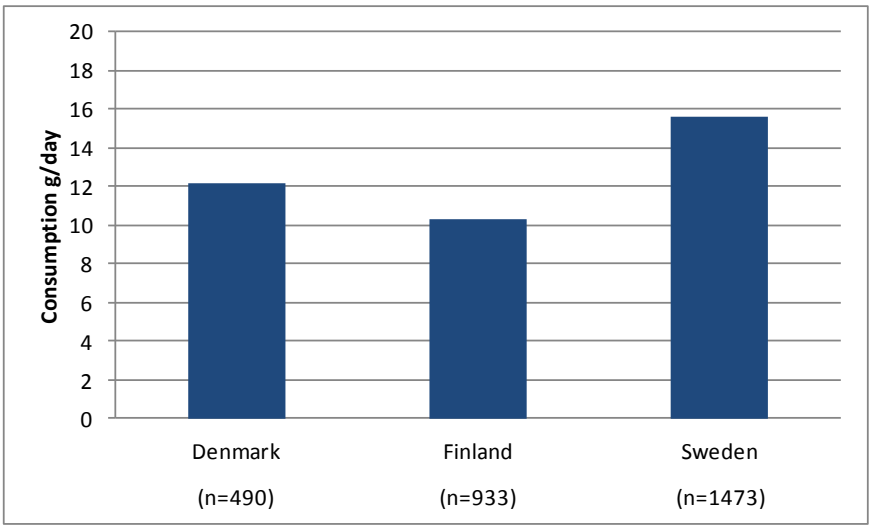
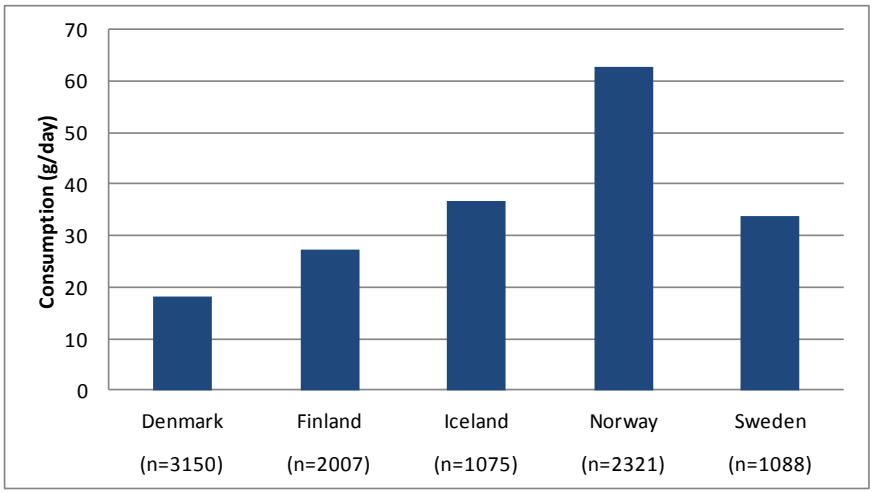
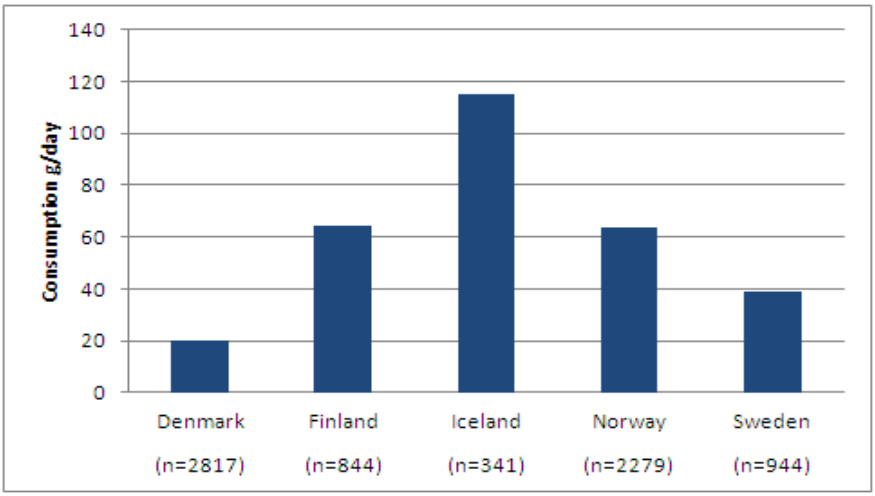


Figure 3. Mean consumption (g/per day) of fish and seafood among adults in the Nordic countries. (EFSA 2011a)



*In Iceland the consumption data is based on one 24-hour recall.

Figure 4. Mean consumption (g/per day) of fish and seafood among consumers (adults) in the Nordic countries. (EFSA 2011a)



*In Iceland the consumption data is based on one 24-hour recall.

3.5 Examples of food intake in selected food groups

The current problems in the western diet are high consumption of sugary foods and drinks, low consumption of fruit and vegetables and decreasing consumption of whole-grain bread. Nordic cooperation has also studied the best practice scenarios to ensure the better health of adolescents (Berg Christensen et al. 2011). The "New Nordic Diet" has been launched to promote regional food patterns for healthful eating and environmentally sustainable food selections (Bere & Brug 2008). The traditional ingredients such as berries, cabbage, fish, birds, rapeseed oil and local grains represent local food choices and may provide the basic nutrients needed (Mithril et al. 2012).

The NORDIRA project decided to look at specific food items in order to compare data in the national dietary surveys. The group chose to focus on health-enhancing or undesirable food habits: vegetables, high-fibre bread and beverages. The aim of this exercise was to test the feasibility of doing specific searches and reports concerning national surveys. By comparing consumption of these food items, we can compare the healthiness of food habits in the Nordic countries. The criterion set for the fibre content of high-fibre bread (more than 6 grams per 100 g) is the same as it was in the NORBAGREEN study (Similä et al. 2003).
Consumption of sweetened beverages and vegetables is of special interest when examining healthy food choices among adolescents. Consumption figures for these selected food products in Denmark and Finland are presented and compared in Figures 5 and 6. Detailed consumption data could be prepared only from Finland and Denmark and for that reason the data from these two countries is shown as an example (App. A1–A6). In Denmark boys and girls consumed more beverages with sugar than boys and girls in Finland. Among Danish boys consumption of beverages with sugar was remarkably high, almost 400 ml/d.

Figure 5. Consumption of beverages with sugar, artificially sweetened beverages and vegetables among 13–15 -year-old Danish boys and 13–14 -year-old Finnish boys. The consumption data was collected during 2005–2008 in Denmark and in 2007 in Finland

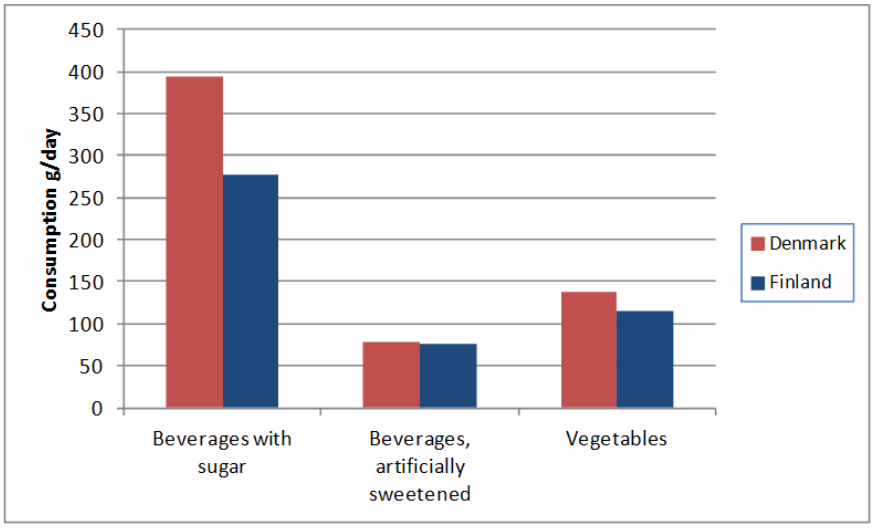
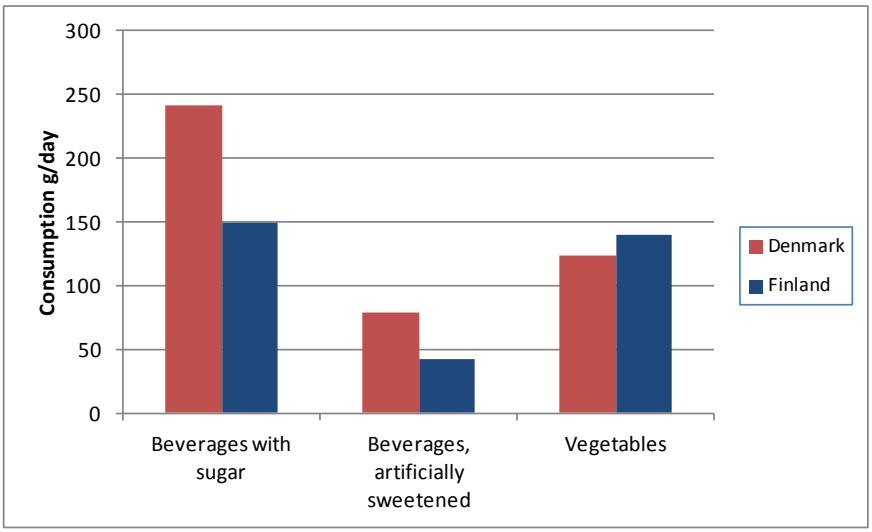


Figure 6. Consumption of beverages with sugar, artificially sweetened beverages and vegetables among 13– 15 -year-old Danish girls and 13–14 -year-old Finnish girls. The consumption data was collected during 2005–2008 in Denmark and in 2007 in Finland



The consumption of beverages with sugar was highest among Danish men aged 25–30 years, who consumed approximately 400 g/day of these products (Figure 7). Among older age groups consumption of sugary beverages was substantially lower.

Among men and women the consumption of beverages with sugar or artificial sweeteners was also more common in Denmark than in Finland (see App 8. Tables A1–A6). Among adults, the consumption of beverages with sugar was highest among the youngest age group although the amount consumed was substantially lower in women than among men (Figures 7, 8).

Figure 7. Consumption of beverages with sugar, low-fat milk and high-fibre bread among men in different age groups in Denmark and Finland. The consumption data was collected during 2003–2008 in Denmark and in 2007 in Finland

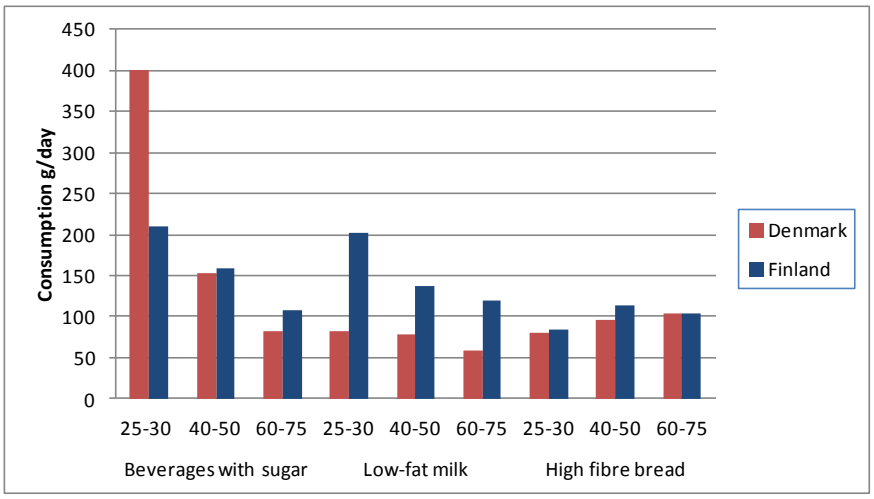
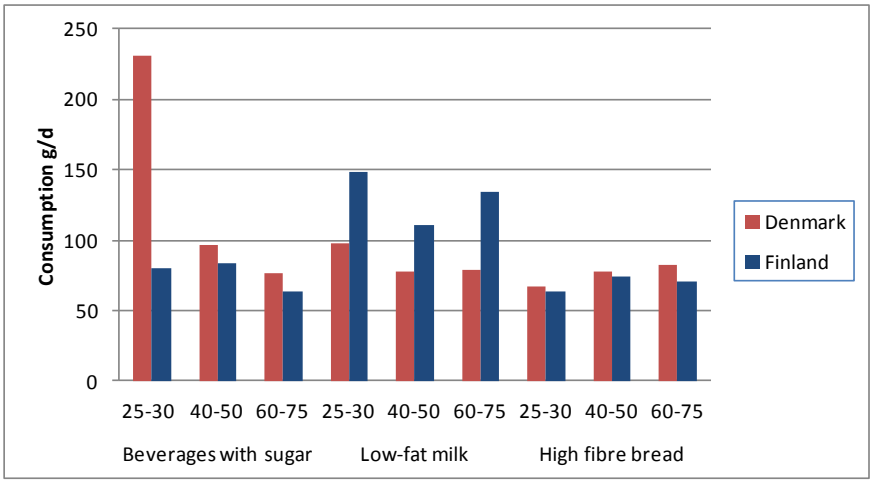


Figure 8. Consumption of beverages with sugar, low-fat milk and high-fibre bread among women by age in Denmark and Finland. The consumption data was collected during 2003–2008 in Denmark and in 2007 in Finland



The results of consumer proportions were obtained from Denmark and Finland and are presented in Tables A1–A6 in the Appendix 8. Low-fat milk was consumed by half of Danish and Finnish children and women, but consumer proportion was lower in men. It seems that among the Danes, consuming low-fat sour milk was much more common than among the Finns, but this may result from the different definitions of sour milk.

The amount of daily consumption of high-fibre bread (>6g fibre per 100 grams of bread) was rather similar in the two countries. High-fibre bread was consumed by most Danes but by 80 % of Finnish people. Vegetables are included in the daily diet both in Denmark and Finland, but in both countries, the amount of consumed vegetables was lower than recommended.

The differences in consumer proportion may be due to the dietary method which was 7 days' diary in Denmark and 48-hour dietary recall in Finland. Consumer proportion demands a clear definition, if a consumer is person who consumed the food item on one of the days or on every day. Whole grain consumption has been a focus of interest in the HELGA cohort where the median consumption of whole-grain products varied from 64 g per day in Swedish women to 114 g per day in Norwegian women (Kyrø et al. 2012). One third or less of the Scandinavian people met the recommendation for whole-grain consumption.

The next chapter presents some specific results concerning the distribution of nutrient intakes. The food groups and nutrients were selected in

order to describe the achievement of dietary guidelines and recommendations. A moderate agreement of dietary method used in Denmark, precoded food diary, and 4-day food diary was found when validity of these two methods was studied among 72 volunteers (Knudsen et al. 2011)

The test revealed that a data search for common criteria is too laborious to be carried out unless there is a research or governmental aim in doing so. The main food categories (see Tables 5 and 6) are the same in all the Nordic countries, but the subgroups usually differ. The search for sugary and artificially sweetened drinks and harmonized definition of such food groups demanded a specific classification and extra work.

3.6 Nutrient intakes in the Nordic countries

The average energy intake among Nordic children aged around 4 years varied from 5.5 MJ per day (Finnish girls) to 7.7 MJ (Danish boys; Table 7). The average intake of fat accounted for between 31 – 34 per cent of energy (E%) among children. The intakes of saturated fat are quite similar. Sugar intake was above recommendations, and was the highest among children in Norway. There were differences in the intakes of vitamin E and D. The highest intake of vitamin E among children aged 4–5 years was seen in Denmark, almost 8 mg per day. The intake of vitamin D, including intake from dietary supplements, is highest in Finland, but nevertheless does not reach the recommended level of 7.5 µg/day (NCM, 2004). The lowest intake of calcium was in Norway whereas in other countries the intake was at least 800 mg/day.

The highest fibre intake was noticed in Denmark. The definition of dietary fibre may vary in the Nordic countries but the definitions were not included in the national reports.

Table 7. Average nutrient intakes among preschool children

		Energy MJ	Fat E%	SFA E%	Sugar %E	Fibre g	Vitamin C mg	Vitamin E mg	Vitamin D[5] µg	Calcium mg
DK[1]	Girls (78)	7,0	34	15	12	16	78	7,9	2,2	983
	Boys (81)	7,7	34	15	11	18	88	7,6	2,2	1,030
FI[2]	Girls (247)	5,5	31	14	14	9	61	5,1	6,1	930
	Boys (307)	5,8	31	14	14	10	60	5,5	5,9	983
NO[3]	Girls (206)	6,1	32	14	16	12	68	4,4	2,4	667
	Boys (185)	6,3	33	14	15	12	66	4,6	2,7	684
SE[4]	Girls (288)	6,1	32	15	14	11	74	5,9	6,5	819
	Boys (302)	6,5	31	14	14	12	71	6,0	6,7	889

[1] Danskernes kostvaner 2003–2008, 4–5 years old (Pedersen et al. 2010)
[2]The Diet of Finnish Preschoolers, 4 years old (Kyttälä et al. 2008)
[3]UNGKOST-2000 (Øverby & Frost Andersen 2002)
[4] Riksmaten – barn 2003, Livsmedels- och näringsintag bland barn i Sverige, 4 years old (Enghardt Barbieri et al 2003)
[5] Supplements included in the Finnish figures.

Adults also had quite similar nutrient intakes in the three Nordic countries where dietary surveys covering the 2000s were available (Table 8). Dietary surveys including adults were not available from Norway and Sweden. Energy derived from fat accounted for over 30 E% in all countries but the level was highest in Iceland. The intake of saturated fat varied from 13 to 15 E%. Sugar intake varied from 10 E% to 11 E%. Vitamin E intake was highest in Finland, but the intake was almost 7 mg/day in all countries. Vitamin D intake of adults was extremely low in Denmark, only 3,0 µg/day, as was the case among Danish children, too. The intake of vitamin D did not reach the recommended levels even in the other countries. The differences in vitamin D intake may be due to differences in fortification policies and in guidelines regarding supplement intake in the Nordic countries.

Table 8. Average nutrient intakes among adults in Denmark, Finland and Iceland.

		Energy MJ	Fat E%	SFA E%	Sugar E%	Fibre g	Vitamin C mg	Vitamin E mg	Vitamin D µg	Calcium mg
DK[1]	Women (1785)	7,9	32	13	9	19	108	6,7	3,0	940
	Men (1569)	10,4	33	14	8	21	101	7,6	3,7	999
FI[2]	Women (1080)	6,6	31	12	10	21	114	8,0	5,5	984
	Men (959)	8,9	33	13	10	24	97	9,9	7,5	1,162
IS[3]	Women (-)	7,5	35	15	10	-	83	7,5	5,1	939
	Men (-)	10,6	36	15	11	-	80	10,0	7,1	1,232

[1] Danskernes kostvaner 2003–2008, 18–75 y
[2] FINDIET 2007, 25–74 y
[3] The Diet of Icelanders 2002, 15–75 y

The NORDIRA project examined the harmonization of reporting by calculating the intake distribution of a number of specific nutrients in addition to the average intake included in the main reports of each study. The distribution of nutrient intakes will be presented in mean, median, 10th and 90th percentiles for the selected nutrients. The NORDIRA group decided to select nutrients that could reflect healthy dietary habits in each country and then compare them between countries. The nutrients under examination were macronutrients, fibre, vitamins A, D, E, C, folate, calcium and iron (Appendix 8, Tables A7–A15). This test was completed in Denmark and Finland.

4. Intake distribution of folate and vitamin D

Intake of folate among fertile-aged women and intake of vitamin D among all age groups are of special interest with respect to the sufficiency of nutrient intake. According to the Nordic nutrition recommendations the recommend folate intake for fertile-aged women is 400 µg/d. Intake is in accordance with the recommendation only among Danish women. The lowest daily intake is seen among Swedish women, whose intake is only about half of the recommended amount (Table 9). Again, there are differences in the definition of folates for which the concentrations may be analyzed by microbiological analysis or by HPLC. It is not certain whether the recommended nutrient intake values can account for the differences in folate definitions.

Table 9. Folate intake statistics among fertile-aged (20–45 years) Nordic women.

	Age group	N		Mean	Median	10th percentile
Danish[1]	25–34	340	µg/10MJ	381	358	253
	35–44	412	µg/10MJ	398	360	258
Finnish[2]	25–45	421	µg/10MJ	320	298	191
Icelandic[3]	20–39	-	µg/d[3]	280	–	–
Swedish[4]	25–34	132	µg/d[4]	206	–	146
	35–45	132	µg/d[4]	223	–	135

[1]Danskernes kostvaner 2003–2008

[2]FINDIET 2007

[3]The Diet of Icelanders 2002, mean energy intake for all women 7.5 MJ/d

[4]Riksmaten 1997–1998, mean energy intake 7.8 and 7.7 MJ/d

The adequacy of vitamin D intake has been under evaluation, because during the wintertime people do not produce vitamin D through skin exposure to ultraviolet light (Pedersen et al. 2008). The dietary intake of vitamin D was not a determinant of vitamin D status in Denmark (Thuesen et al. 2012); instead, the determinants were high BMI, smoking, sedentary lifestyle and unhealthy diet. The Danish study lacked data on supplement use, and only a few fortified foods were available. Most studies confirm that supplement consumption is associated with better lifestyles and diet and this may have an effect on the Danish results. In European countries, a first trial has been carried out to assess the safety

of the vitamin D intake from foods, fortified foods and supplements (Flynn et al. 2009).

Strong seasonal variation in serum levels of 25-hydroxyvitamin D has been observed in the Nordic countries (Pedersen 2008 et al., Thuesen et al. 2012). The dietary intake has been low in Finland (Hirvonen et al. 2007) and in the other Nordic countries (Tables 10 and 11). National food policies have implemented various solutions for the recommended fortification of food items (Rasmussen et al. 2006). In Finland, milk products and dietary fats are fortified with vitamin D and the fortification level was increased further in 2010. However, vitamin D may have toxic effects and thus it is necessary to estimate the association between fortification levels and the risk of exceeding safe intake levels (Hirvonen et al. 2007). There are good reasons to continue assessments of safe intake of vitamin D, especially in countries where the use of vitamin D supplements is common. It has been estimated that food supplements were responsible for the largest differences in total intakes (Flynn et al. 2009).

Table 10. Vitamin D intake (µg/d) among school-aged children.

		N	Mean (SD)	Median	10th percentile	90th percentile
Denmark[1]	Girls	196	1,9 (1,7)[5]	1,5[5]	0,8[5]	2,6[5]
	Boys	164	2,6 (1,8)[5]	2,0[5]	1,3[5]	4,5[5]
Finland[2]	Girls	170	5,0[6]	4,5[6]	1,9[6]	7,9[6]
	Boys	136	6,6[6]	6,1[6]	2,8[6]	10,3[6]
Norway[3]	Girls	517	2,4 (2,5)[7]	–	–	–
	Boys	492	2,8 (3,0)[7]	–	–	–
Sweden[4]	Girls	499	4,4 (2,6)[8]	3,8[8]	1,8[8]	7,3[8]
	Boys	517	4,8 (2,8)[8]	4,1[8]	2,1[8]	8,0[8]

[1]Danskernes kostvaner 2003–2008, 10–13-year-olds included.
[2]The diet of secondary school pupils 2007–2008, children in the 7th and 8th grade included.
[3]Ungkost-2000, children in the 8th grade included
[4]Riksmaten children 2003, children in the 5th grade included
[5]Supplement intake not included
[6]Supplement intake included
[7]Supplement intake not included
[8]Supplement intake included

Table 11. Vitamin D intake (µg/d) from foods among adults in the Nordic countries.

			Mean µg/d(SD)[6, 7]	Median	10th percentile	90th percentile
Denmark[1]	Women	1,889	3,0	2,1	1,0	6,5
	Men	1,639	3,8	2,7	1,4	7,1
Finland[2]	Women	1,080	5,5	-	-	-
	Men	959	7,5	-	-	-
Iceland[3]	Women	-	5,1 (9,7)	-	-	-
	Men	-	7,1 (10,9)	-	-	-
Norway[4]	Women	1,374	4,0	-	-	-
	Men	1,298	5,8	-	-	-
Sweden[5]	Women	626	4,9(1,9)	4,7	2,7	7,5
	Men	589	6,2 (2,7)	5,7	3,2	9,5

[1]Danskernes kostvaner 2003–2008, 15–75-year-olds included
[2]FINDIET 2007, 25–74-year-olds included
[3]The Diet of Icelanders 2002, 5–80-year-olds, total 1399,
[4]Norkost 1997, 16–79-year-olds included
[5]Riksmaten 1997–1998, 18–74-year-olds included
[6]Supplements not included
[7]Cod liver oil included in Iceland.

In Finland the fortification of food items has been studied with various models and alternatives (Hirvonen et al. 2007). In the early 2000s, the fortification level was low and studies showed only a slight decrease in the hypovitaminosis of vitamin D (Välimäki et al. 2007, Lehtonen-Veromaa et al. 2008). The national nutrition council recommends higher levels of supplementary vitamin D for both children and the elderly (VRN 2010). In Finland, the Ministry of Trade and Industry issued a statement on the fortification of foods in 2003. Margarines had been fortified with vitamin A and D since the 1950s, but this procedure did not have much of an effect on vitamin D intake. Since 2003 fat spreads have been fortified with 10 µg/100g. Fortification of fluid milk products started in 2003 with 0.5 µg vitamin D_3/100ml and since 2010 the recommended amount for liquid milk products has been 1µg/100ml. Organic milk and butter are not fortified.

In Denmark food fortification has been very limited and except for table margarines fortified with vitamin D at levels between 7.5 µg to 10 µg per 100 g, no food items fortified with vitamin D were available on the Danish market before spring 2011. Since spring 2011 a few producers have voluntarily fortified their products and introduced low-fat milk with 0.75 µg/100 ml to the Danish market. A few types of bread are fortified as well (Thuesen et al. 2012).

In Norway only extra low-fat milk has been fortified with 0.4µg/100g. In 2006 a working group evaluating action to improve vitamin D status among Norwegians proposed that all milk should be fortified with 0.4 µg/100g and that the fortification of margarines and other fat spreads should be increased from 8 to 10 µg/100g and cooking oils should be fortified in the same way as margarine (Meyer et al. 2006).

4.1 Comments on intake estimation

Methodological differences can cause some variation in the results. It is well known that food diaries may change food habits because the person becomes conscious of his or her consumption (Willett 1998). The usual aim of national dietary surveys is to assess the average nutrient intake in selected subgroups of the population. All the methods are suitable for arriving at mean figures if the number of subjects is big enough. A variety of methods have been applied in the Nordic countries. In the case of children, it is advised that a short registration booklet should be used as a memory aid, and that the out-of-home consumption should be captured (not in the presence of parents).

The definition of consumers is highly dependent on the dietary method. Is the consumer a person who is using vegetables during one of the interview days or are we interested in the daily consumers who consume vegetables on every day of the interview.

Comparison of food consumption can be harmonized by means of exact definitions of food groupings. Food groups are based mainly on the similar biological origin of food items or on cultural traditions. The NORDIRA project collected published data on food consumption and there is slight variation in the definitions of food groups from country to country. Also the reporting and calculation of food consumption may differ and cause variation in the results. For example, differences in the figures for the consumption of fruit and vegetables can be explained by the methodological differences in recording the data: inclusion or exclusion of peels in the consumption calculations can have a slight effect on the amounts recorded as eaten.

Nutrient intake estimates also depend on the calculation procedures and harmonization of nutrient factors in food composition databases (Willett 1998). The calculated nutrient intakes are comparable if the calculation procedures include the same dietary supplements or if the calculations apply coefficients to take into account nutrient losses due to

preparation steps into account in a similar way (Norfoods 2002, de Neve et al. 2010).

The project group of the Nordic Nutrition Recommendations (NCM 2004) assessed Nordic diets at the beginning of the 2000s. The nutrient density of average national diets was below the recommended level in all Nordic countries. There were also differences in nutrient density between the five countries, such as in vitamin D, calcium or iron. The differences in nutrient intake estimates can be due to food habits (fish), fortification of food items and different composition of fertilizers (e.g. selenium).

When comparing nutrient intake estimates between Nordic countries, it must also be kept in mind that there may be differences in the definition of nutrient factors. For example, the definition of fibre varies in the food composition databases. Cooperation within the Nordic countries has promoted harmonization in calculation procedures from food consumption to nutrient intakes (Becker et al. 2000).

In conclusion, the main food categories are the same, but in order to arrive at more specific food groups, a flexible data calculation procedure is needed. The main food categories in the reports of Nordic dietary surveys are comparable with those defined in EFSA's FoodEx (see Chapter 3.4).

5. The applications of food consumption for risk assessment

5.1 General concepts in risk assessment

Foods may contain chemical or microbiological agents that are potentially harmful to the health of consumers (Table 12). This chapter focuses on the quantitative assessment of exposure to chemical substances from food for the purposes of risk assessment. Risk assessment is defined as a process that involves the identification of the hazard, description of the exposure, and characterization of the risk.

Exposure assessment in food safety is a quantitative evaluation of the probable intake of chemical agents via food (Kroes et al. 2002). Food consumption data concerning populations and subgroups are used for assessing dietary exposure to potentially harmful chemical substances such as pesticides, food additives, heavy metals, plant toxins, and other contaminants as well as substances that are added to food or food supplements for their beneficial effect, but which could be harmful if consumed in excessive doses, including not only vitamins and minerals, but also plant-based ingredients.

Table 12. Categories of food-based chemical hazards

1.Chemical residues	Pesticides
	Veterinary drug residues
2. Environmental contaminants	Persistent organic pollutants (POP)
	PCBs
	Perfluorinated organic compounds
	Dioxins
	Brominated flame retardants
	Heavy metals
	Cd, Pb, Hg, Ag
	Nano particles
3. Natural toxins	Mycotoxins (e.g. Fusarium, aspergillus)
	Nitrate, nitrite (Also used as preservatives)
	Coumarine
	Caffeine
4. Food processing contaminants	Acrylamide
	Furan
	PAHs

5. Food additives	Colours[1] Sweeteners Antioxidants Preservatives, emulsifiers, flavour enhancers, etc.
6. Nutrients and non-nutrients	Plant-based food supplements[2] Fortification (potential hazards) Vitamin A Vitamin D Food supplements
7. Food contact materials	
8.Flavouring substances	
9. Processing aids	Extraction solvents
10. Food enzymes	

[1] Expochi (Huybrechts et al. 2011)
[2] PlantLIBRA

Ideally, the occurrence data are based on quantitative analytical measurement of potential chemically hazardous agents in representative food samples. If quantitative occurrence data are not available, other figures may be used when relevant, e.g. upper permitted levels. Hazardous chemicals are not covered in the national food composition databases. In Iceland, MATÍS ltd. – Icelandic Food and Biotech R&D, an independent research institute, has developed a web-based database for undesirable substances in Icelandic Marine catches (Matis 2012) (http://www.matis.is/media/valadskotaefna/ValAdskotaefna.swf).

In Finland, data on the occurrence of chemically hazardous substances are recorded in case-specific datasheets without any general data structure. Norway does not maintain a structured database of occurrence data, either. Before an exposure estimate is carried out, the link between food groups and an analyzed food item that contains a contaminant is ascertained for each substance.

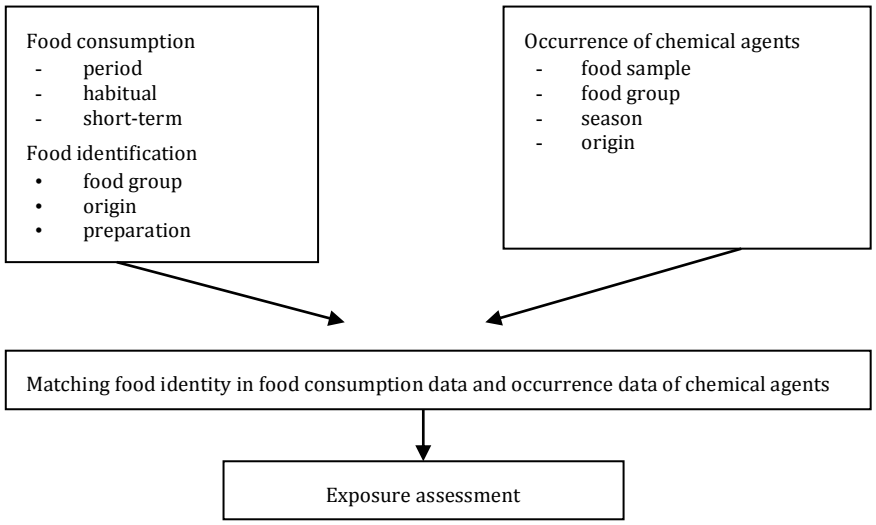
One of the reasons for the lack of databases is the complex nature of chemical agents. Chemically hazardous agents involve the occurrence for several isomers and the data is structured in a hierarchy. Also the analyzed food items may consist of several samples differentiated by origin, species and other descriptors. The sampled food items do not necessarily match the product types defined in the food composition database.

Risk assessment may be carried out using a deterministic model with a fixed figure for food consumption and fixed concentration of chemical substance (e.g. caffeine, Meltzer et al. 2008). In other cases, a probabilistic model describing the exposure distribution has been applied (e.g. pesticides, Laakso et al. 2010).

Food consumption data and occurrence data in food are combined in order to estimate exposure to a potential harmful substance. Individual data on food consumption is available from quantitative dietary surveys and is usually summarized in terms of food groups. In the reports of Nordic dietary surveys, the number of main food groups varies around 20. At the main group level, the food classification used in these surveys is largely similar to EFSA's harmonized food classification FoodEx (EFSA 2011b). For risk assessment, specific sub-groups are often preferred, and in some cases specified food items are needed. Body weight data is essential in exposure and risk assessment because ADI and TDI values are expressed per kg body weight.

In practice, national experiences reveal that matching food consumption and occurrence data is carried out occasionally for calculations of risk exposure. The matching is best achieved if the aggregation of food consumption and the concentrations of occurring chemical substances correspond to each other as closely as possible.

Figure 9. Linking and matching food consumption and occurrence data of chemical agents



Risk assessment can also focus on nutrients. The contribution of food, fortified foods and food supplements was evaluated at the European level (Flynn et al. 2009). The major contributor of nutrient intakes was the food items of the basic diet. The proportion of intakes from fortified food items varied by country and at the time of the study the consumption of fortified food items was limited. The consumption of food supplements varied by

subject and was the cause of the largest differences in the total intakes. However, data concerning the intakes of added nutrients from fortified foods were only available in a few European countries.

It was emphasized that risk-benefit assessment requires collaboration between different areas, and the scaling of positive and negative health effects has to be developed. Nordic countries have applied risk-benefit assessment in fish consumption (Sand et al. 2008). Other potential areas for risk-benefit assessment are consumption of fruit and vegetables and exposure to pesticides. In the case of fish consumption, the feasibility of biomarkers, which may be a biochemical or its metabolite, has been studied in relation with contaminant exposure (Turunen et al. 2010, Brantsaetser et al. 2010). Fish consumption has been measured to be highest in Norway, followed by Iceland and Finland, the countries that have been the most actively studying the risks and benefits of fish consumption.

Table 13. National recommendations for fish consumption

	General recommendations	Exceptions
Denmark	200–300 g/week[1]	Avoid large predatory fish: Pregnant, lactating women Children under 14 y
Finland	200 g/week[2]	Baltic fish <2/month[3] Predatory fish from inland waters – do not eat daily Avoid large predatory fish: Pregnant, lactating women Children under 14 y
Iceland	Consume fish at least 2 times per week as a meal or bread spread[4]	Pregnant and lactating women should avoid certain species[5]
Norway	Food-based dietary guidelines state: Eat fish for dinner 2–3 times/week.	
Sweden[6]	250–375 g/week	Fish from the Baltic Sea not recommended for children or pregnant and lactating women
	Common guideline: Vary lean and fatty fish and fish species	

[1] Danish Veterinary and Food Administration
[2] Finnish National Nutrition Council 2005
[3] The Finnish Food Safety Authority Evira
[4] Public Health Institute of Iceland (2006)
[5] Public Health Institute of Iceland
[6] Livsmedelsverket

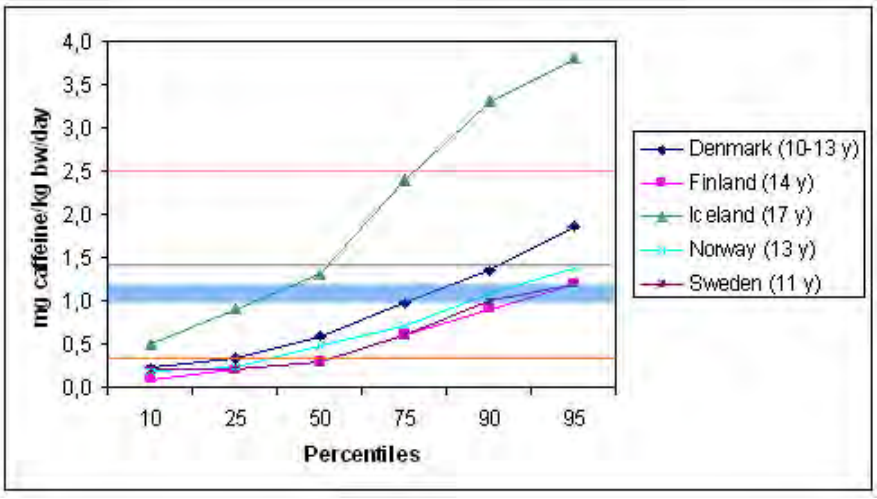
Safe fish consumption has been evaluated in the Nordic countries and each country has issued relevant guidelines (Table 13). So far, the scientific conclusion is that the benefits of weekly fish consumption outweigh the adverse effects (Hoekstra et al. 2012). Risk-benefit analyses cover several fields such as microbiology, the environment, nutrition and food marketing. Several Nordic countries have participated in research for improving risk-benefit analysis in the search for best practices, policy strategy and food regulation (Tijhuis et al. 2012).

5.2 National cases in exposure to chemical substances

Examples of applications of national dietary surveys for risk assessment in the Nordic countries are presented in the Appendix 9 (Table A16). The examples are from studies that have been carried out since 2000. The aim of the risk assessment and the used food consumption data are presented. Several governmental research institutes were typically involved in the exposure activities. This describes the location of expertise in various research sectors. The number of experts needed to solve specific exposure issues is huge and the completion of tasks demands a common language and orientation. Some of the difficulties faced in opan-European project are presented by de Neve et al. (2010).

Nordic-wide estimation of the exposure to caffeine has been carried out in recent years (Meltzer et al. 2008, Figure 9). The exposure to caffeine among Nordic children aged 4–6 years was below the NOEL for tolerance development in the case of approximately 50% of these children. Ten per cent of the children with the highest consumption exceeded the level where tolerance may develop and approximately 20% of teenagers might, due to their consumption of caffeine-containing soft drinks, be exposed to levels of caffeine inducing anxiety and jitteriness.

Figure 9. Caffeine exposure (mg/kg bw/day) from cola drinks in 11- to 17-year-olds in the Nordic countries (consumers only) compared with the threshold values suggested in the hazard characterisation (Meltzer el al. 2008)



The (blue) area between 1 and 1.25 mg/kg bw indicates the range where effects, i.e. withdrawal symptoms, can be observed. The (orange) line at 0.3 mg/kg bw indicates the NOEL. At 1.4 mg/kg bw (grey line), sleep disturbances are observed in adults. The (red) line at 2.5 mg/kg bw denotes the effect level (LOAEL) for anxiety. The Finnish, Icelandic and Swedish intake estimations are based on actual consumption data, while the Danish and Norwegian intake estimations are based on the assumption that cola drinks comprise 60% of the total soft drink consumption.

Some Nordic countries have a shared interest in assessing exposure to heavy metals, dioxins, PCBs, and polycyclic aromatic hydrocarbons (PAH) (see Appendix 9, Table A16).

National cases as experiences

The Nordic countries share a number of common interests regarding dietary risk assessment (Table 14). Estimation of the adequacy of vitamin D intake has been the aim in Finland and Norway. In Finland, specific national targets for risk assessment have also been set for lead, chromium, selenium and food colours, in Norway for PAH compounds and in Sweden for acrylamide.

Table 14. Similarities of dietary risk assessment in the Nordic countries

	Country	Target group
Chemical risk assessment		
Cadmium, Cd	Finland, Sweden	Adults
Mercury, Hg	Norway, Sweden	Adults
PCBs	Iceland, Norway	Adults
Dioxins	Iceland, Sweden	Adults
Caffeine	Finland, Iceland	Adolescents, adults
Nutritional risk assessment		
Vitamin A (via liver foods)	Finland, Sweden	Children, adults

Cases from Denmark

The intake of intense sweeteners from non-alcoholic beverages was estimated in a Danish study (Leth et al. 2008). In 2005, 76 out of 177 analyzed samples of non-alcoholic beverages were found to contain the intense sweeteners cyclamate, acesulfame-K, aspartate and saccharin. The estimated intake of the sweeteners was calculated using the Danish Dietary Survey based on 3,098 persons aged 1–80 years. Dietary data were recorded on 7 consecutive days. The questionnaire included 20 beverages (e.g. different types of milk, beer, wine, soft drinks and fruit juices). Sweetened beverages included two types of beverages with carbon dioxide – "light" soft drinks and soft drinks sweetened with sugar – and two types of beverages without carbon dioxide – "light" soft drinks and soft drinks sweetened with sugar (this category included fruit juices). For each person, the registered average daily intake of the four categories was multiplied with the content of intense sweetener and the calculation of the basic statistical parameters of intake distribution was carried out in age groups, males, females and the total population. For the content of intense sweetener, two scenarios were used. The first, called 'high intake', simulated situations involving brand-loyal consumers and used the analytical determined mean value for all the light samples containing a specific sweetener. The second, called 'average intake', used the analytical determined mean value for all the light samples in the category. According to the study the estimated intakes of intense sweeteners were below their respective ADI values.

The study of Leth et al. (2010) estimated the intake of benzoic and sorbic acids. The content of benzoic and sorbic acids in all food groups in which they are allowed was monitored in Denmark 17 times between 2001 and 2006 with a total of 1526 samples. The median daily intake and intake distribution of benzoic and sorbic acids were calculated with the data from the Danish National Survey of Dietary Habits and Physical Activity which was conducted in 2000–2004 with 5785 participants (age from 4 to 75 years). Dietary data were recorded on 7 consecutive

days. A combination of food quantification methods (household measures and estimation from photographs of different portion sizes) was used.

The median intakes of both benzoic acid and sorbic acid were well below the acceptable daily intakes of 0–5 and 0–25 mgkg^{-1} body weight (bw) day^{-1} for benzoic acid and sorbic acid, respectively. However, the 90th percentile based on the average of the samples with a content of benzoic acid is higher than the acceptable daily intakes for both men and women, with the highest value being 16 mg kg^{-1}bw day^{-1} for both boys and girls in the 4–6-year-old age group. Soft drinks, salads and dressings were the main contributors to benzoic acid intake. The sorbic acid intake based on the average of all samples was well below the acceptable daily intake.

Cases from Finland

Intake estimates of pesticides (Laakso et al. 2010) were completed based on 3-d food diary consumption data on Finnish children and 48-hour food recall among Finnish adults. Food consumption data was modified at the Institute for Health and Welfare according to the occurrence data of plant protection products from the Finnish Food Safety Authority Evira. Cooperation in matching these two datasets (consumption data and occurrence data) is a necessary step in each risk estimation case.

Some of the food categories of the Fineli system were applied and a number of specific food items were used for the consumption figures. The detailed description of food items was essential for the matching of food items in the occurrence data and in the consumption data.

Exposure was estimated per kg body weight using a probabilistic model. Dietary exposure to residues of plant protection products was characterized by a low chronic level. However, the exceeding of acute reference doses (aRfDs) of carbamates and organophosphates was observed among children and adults with a probability higher than 0.01%. The use of the major carbamates and organophosphates has currently been prevented, but the monitoring of exposure in sensitive subpopulations should be continued.

Fish consumption and methylmercury (MeHg) intake from species most commonly used in Finland were assessed in susceptible age groups of children from 1 to 6 years old (Karjalainen et al. 2012). Calculated intakes were compared to international recommendations. Safety margins and the proportion of children exceeding the tolerable daily intakes set by international expert bodies were also examined. The fish consumption of the children was recorded by their parents and day-care personnel using 3-day food diaries. Food consumption was calculated at an ingredient level using in-house software and the Finnish Food Com-

position Databank FINELI. Fish consumption data was presented in terms of probability distribution.

MeHg intakes among Finnish children varied greatly between individuals and ages: the daily intake of MeHg ranged from 0 to 0.33 µg/kg body weight. The strictest reference value, 0.1 µg/kg body weight/day for MeHg, which was proposed by the US Environmental Protection Agency (USEPA, 2001), was exceeded by 1–15% of the study population. The provisional tolerable weekly intake (PTWI) proposed by FAO/WHO Joint Committee on Food Additives and Contaminants (JECFA 2006), 1.6 µg/kg body weight, was exceeded by 1% of boys and 2,5% of girls aged 6 years.

Cases from Iceland

Activities in Iceland have mainly focused on fish consumption, its nutritional composition and pollutants (Reykdal et al. 2011, Hoekstra et al. 2012).

Cases from Norway

Norwegian examples are from "the Norwegian Fish and Game Study and the Lake Mjøsa Study. The following descriptions and results are based on several studies: Meltzer et al. 2002, Bergsten 2005, Birgisdottir et al. 2012, Knutsen et al. 2011, Haug et al. 2010Kvalem et al. 2009, Knutsen et al. 2008, Thomsen et al. 2008.

The aim of the *Norwegian Fish and Game Study (NFG study)* was to obtain information about the levels of dietary intake of environmental contaminants in the Norwegian population, in the general population, in chosen areas and among individuals with high intake of food known to contain significant levels of environmental contaminants. This was a three-stage survey (stages A, B and C) with main focus on mercury, cadmium, PCB and dioxins, but other contaminants of interest are included in Part C.

Part A of the NFG study was a national survey of the consumption frequencies relating to specific foods considered to contain potentially high levels of environmental contaminants. In 1999, ten thousand people were invited to participate, and the response rate was 60%. One of the main findings of Part A was that regional differences are the main explanation for differences in the consumption of fish and game. The study also confirmed that the consumption of food with potentially high levels of contaminants was skewed in the population, and that parts of the Norwegian population might thus be highly exposed to environmental contaminants.

Part B was a regional survey in 27 selected inland and coastal municipalities with good access to hunting and fishing locations. Due to the ample supply of seafood and/or game in these municipalities, it was expected

that consumption of relevant foods would be higher than in the majority of the population. The goal of the instrument in Part B was to identify individuals in the population with high intakes of foods with potentially high exposure to heavy metals and persistent organic pollutants. In the year 2000, 10,000 adults living in the 27 municipalities were selected by random draw and invited to participate in the study and 55% responded. The participants answered a simple questionnaire (although more extensive than in Part A) that covered the consumption of different freshwater and saltwater fish species, fish liver, crustaceans, seagull eggs and game. None of the participants were living in areas of known contamination by persistent organic pollutants or heavy metals greater than what could be considered a background level. One of the main findings from Part B supported the finding from Part A that regional differences are the main explanation for consumption of seafood and game.

Part C carried out exposure assessments on people who frequently consumed foods that might contain high levels of environmental contaminants. The general aim was to investigate whether the consumption among individuals with high exposure would reflect in higher concentrations of the chemicals in blood and urine and whether the exposure would lead to intake over the tolerable intake set by international organization. A two-stage inclusion strategy was adopted to recruit participants with a wide range of dietary exposure to contaminants. The participants from Part B known to have high intake of food high in mercury, cadmium or dioxin and PCB were invited to participate in an in-dept study, as well as a reference group randomly chosen from the remaining participants in Part B. Participation rate was 30% in each group, resulting in 117 high consumption participants and 77 in the randomly selected reference group. No significant differences were found with regard to demographic factors or the estimated contaminant exposure from diet between those from Part B accepting to participate in Part C or not, except that participants were slightly older and included a higher percentage of university graduates.

Data was collected in the spring of 2003. After being contacted by mail and giving informed consent in accordance with the Helsinki declaration, participants answered a previously validated semi-quantitative food frequency questionnaire (FFQ), covering their habitual diet during the last 12 months and a 1-page sociodemographic questionnaire. Each of the participants had to make an appointment with their physician to have a blood sample taken, at which time they also delivered a morning urine sample. Informed consent was obtained from all the participants

the study protocol was approved by the Regional Committee for Medical Research Ethics and the Norwegian Data Inspectorate (id: S-02138).

At the time it was known that the *Lake Mjösa* in Norway was contaminated with brominated flame retardants from the group of polybrominated diphenyl ethers (PBDEs) In addition to polychlorinated biphenyls (PCBs). A study population was comprised including consumers of inland fish from Lake Mjøsa. Participants were recruited among 122 local hobby fishermen and women, of whom 74 responded positively to the invitation (61%). Of these, 65 persons (89%) provided blood samples, and filled in the same questionnaires questionnaires as in the Fish and Game Study and a special questionnaire on intake of fish from the lake. Data collection was carried out from October 2004 to May 2005. Informed consent was obtained from all the participants and the project was approved by the Regional Committee for Medical Research Ethics (id: S-04142).

The data from the Fish and Game Study part C and partly the Lake Mjøsa Study has been used to estimate dietary exposure to dioxins, PCBs, PBDEs, perfluorinated compounds (PFCs), mercury (Hg), cadmium (Cd) and arsenic (As). Respective databases on content in food have been constructed at the Public Health Institute. Furthermore, intake of iodine, selenium and vitamin D have been estimated as well as associations between diet and lead in blood. The exposure assessments are based on total food consumption and have been evaluated against the concentration of respective chemicals in blood and/or urine. One of the aims was to investigate whether it was possible to establish a dose-response relationship between food intake and/or exposure assessments and levels of environmental contaminants in blood and/or urine.

Two examples from the Fish and Game Study are given

Kvalem and coworkers (2009) studied the role of dietary patters for dioxin (polychlorinated dibenzo-p-dioxins and dibenzofurans) and PCB (dioxin-like polychlorinated biphenyls and selected non-dioxin-like-PCBs) exposure. Intake calculations were based on an extensive food frequency questionnaire and a congener-specific database on concentration in Norwegian foods. Estimated intakes of sum PCDD/PCDFs and dl-PCBs of the representative and consumers were 0,78 and 1,25 pg toxic equivalent(TEQ)/kg bw/day, respectively. The main source of PCDD/PCDFs and PCBs was oily and semi-oily fish. In the study were identified four dietary patterns of which two were related to high intakes, one dominated by oily fish, the other by fish liver and seagull eggs. Only the latter was closely associated with high blood concentration of dioxin and PCBs.

In 2010 Haug and coworkers explored possible association between concentration of perfluorinated compounds (PFCs) in serum and consumption of food, with particular focus on seafood. Estimated dietary intakes were also compared with determined serum PFC concentrations. The FFQ included various questions on both fish as hot meal and bred spread. The FFQ as well as questions on cod-liver oil or fish-oil supplement use. These were then grouped into consumption of ten different types of seafood. The consumption frequencies were converted into food amounts (g/day) by the use of standard, gender specific portion sizes (Kvalem et al 2009). PFC concentrations in serum were significantly associated with the consumption or lean fish, fish liver, schrimps and meat. Seafood was the major dietary source contributing 38% of the estimated dietary intakes or perfluorooctanoic acid (PFOA), 93% of perfluoroundecanoic acid (PFUnDA) and 81% perfluorooctane sulfonic acid (PFOS). The results of the study indicated that consumption of fish and shellfish was a major determinant or serum PFC concentrations. The tolerable daily intake values (TDIs) for PFOS and PFOA are 150 ng/kg body weight/day and 1,5 µg/kg body weigh/day respectively (EFSA 2008). According to this study mean intakes were about 100 and 2500 times lower than the TDIs for PFOA and PFOS, respectively, and none of the subjects exceeded the TDIs. It should be notices that for the persons having a high intake of fish and shellfish the margin to the TDI could be lower.

The results of The Fish and Game Study and the Lake Mjøsa Study have also been presented in national reports and used in different risk assessments.

Cases from Sweden

In Sweden, the assessment of dietary cadmium exposure was estimated by matching consumption data from Riksmaten 1997–1998 and occurrence data covering the years 1999–2008 (Sand & Becker 2012). Food consumption data was based on the survey on adults conducted in 1997–1998 by the National Food Agency in collaboration with Statistics Sweden (Riksmaten 97–98). Riksmaten 97–98 is based on a 7-day semi-structured food diary and consumption data is available for 1211 adults between 17 and 80 years of age. The consumption data from Riksmaten 97–98 was herein stratified into 31 food categories with subgroups for certain categories (a total of 48 food groups).

Data from the National Food Agency was also used regarding the occurrence of cadmium in different food items. Data was collected as part of the Swedish national monitoring programmes or Swedish market basket surveys between the years 1999–2008. Since the assessment concerned chronic exposure, a mean cadmium occurrence level was

established with regard to each food category. The data from Riksmaten 97–98 was aggregated into 31 broad food categories with subgroups. The body weight-adjusted weekly dietary cadmium exposure for an individual was assessed by taking into account the number of food categories consumed, the average consumption in grams per day of food category, the mean cadmium occurrence level in mg/kg with regard to the food category and reported body weight. The most important food categories for the cadmium intake were potatoes and wheat flour. Differences in dietary patterns between individuals with a high and low exposure to cadmium were observed; for high-exposed individuals, seafood and spinach contributed significantly, with an exposure similar to that which low-exposed individuals received from basic products, potatoes and wheat flour. While the percentage of the population exceeding the tolerably weekly intake (TWI) was lower than 1% for the present data, it was around 3% for the adjusted data, which is more in line with the observations at the level of urinary cadmium.

Sweden has also produced a data model for a contaminant database (Livsmedelsverket 2012). Detailed and standardized sample description is the key factor. As an example the project group considers the cadmium content in various crab meat pieces and the need for very specified sampling. In addition, the geographical origin of samples should be identified in the contaminant database.

Ericson et al. (2007) estimated the dietary intake of heterocyclic amines (HCAs) among the Swedish adult population based on the self-reported intakes of cooked foods from the Malmö Diet and Cancer (MDC) cohort, combined with data on the content of HCAs in various cooked food products. HCA intake was also examined in relation to socioeconomic, lifestyle and other dietary factors. HCA intake was cross-classified against meat and fish intake. The mean daily HCA intake was 690 ng and the subjects were ranked differently with respect to HCA intake compared with intake of fried and baked meat and fish. In this study, the estimated HCA intake was somewhat higher than in another Swedish study (Augustsson et al 1997). This might be due to the used food consumption method; in the MDC study, lunch and dinner meals were registered in a food diary, which might result in higher estimated HCA intakes than in studies using the FFQ. Ericson et al. concluded that although a dietary intake that is close to or below the estimated mean may not be a major health risk, a substantial number of people had intakes far above the mean. The daily average in the 100th percentile for women was 1612 ng. In an earlier Swedish study an increased cancer risk was found for dietary intakes above 1900 ng.

As the examples show food consumption data has been used in risk assessment concerning various food-based chemical hazards including eg. natural toxins, chemical residues, environmental contaminants, food processing contaminants and food additives. Methods of collecting food consumption data differs as well. In some studies food consumption data has been collected especially for the purpose of risk assessment and in some studies food consumption data is based on national dietary surveys.

Comments on dietary data in risk assessment

Information on branded food items and estimates of their consumption may be required for the assessment of some chemical agents such as food additives. The linking of occurrence data and consumption data is troublesome in national data and even more troublesome with several data sources. The linkage has been so far mainly done on national level but more effort is going on in pan-European level. The procedure has encountered difficulties for exposure assessment of food colours, lead, chromium and selenium in children (de Neve et al. 2010). Dietary surveys may provide consumption estimates for certain types of products, such as chocolate bars. It is possible to estimate the market share of a branded product containing silver or other additive and thus estimate the occurrence of a chemical agent. The identification of real consumers of the brand may be more troublesome. Food grouping is case-specific and separate food categorizations have been suggested as a solution (De Neve et al. 2010). It is essential to determine the main objectives of the study and define the food specifications needed for the analyses. As the best solution, a system for identification of food items in consumption data and in occurrence data should be solved simultaneously.

Exposure to agricultural chemical contaminants such as pesticides can be estimated based on the consumption of raw agricultural commodities and the analyzed level of contaminants in commodity samples. EFSA has noticed the need to produce the consumption estimates of raw agricultural products by converting the consumed foods, dishes and beverages into raw commodities. For this task, the management of recipes and the compilation of raw ingredients in the consumption of mixed foods are essential converting procedures.

6. Discussion and conclusions

6.1 Methodological aspects

Dietary surveys have two major steps: the collection of dietary data and the conversion of food consumption into estimates of nutrient intake or exposure of chemical agents. Several studies and reports have stated the importance of the use of standardized methods for the sake of the comparability of results between countries (e.g. The National Food Administration 1986, 1987; NCM 2006). Detailed description of food items and matching food categorisation in consumption data and occurrence data should be ascertained in the study design (de Neve et al. 2010).

The number of recorded days or the time period covered by the dietary method determines whether habitual or short-term estimation of food consumption is available. In statistical procedures, the combination of several intake estimates has been found to be reasonable (Haubrock et al. 2011). The Nordic countries have indeed worked on the standardization of dietary interviews in the 1980s, but national dietary surveys vary by dietary methods in each Nordic country. For example, the 24-hour recall method is used with two consecutive days in Finland, with one day in Iceland and other countries have used diaries. Thus, the recommended method of 24-h recall for two non-consecutive days (Slimani et al. 2002, EFSA 2009) is not achieved in Nordic countries, except the latest Icelandic dietary survey in 2010 (Þorgeirsdóttir et al. 2012).

A food diary is a method for recording eating occasions and consumed foods and drinks over a certain number of days. People can be interviewed about their diet and eating occasions during the preceding days by means of a protocol called a 24-hour food recall. A food frequency questionnaire is a method used for recalling frequencies of consumption of food items or the average frequencies of the consumption of food groups during, for example, the last month/last year. The Nordic countries have chosen different methods, although each has set selecting a less burdensome method as the main criterion. Nor can we conclude if a certain method yields a higher participation rate. Some ideas for Nordic cooperation have raised within NORDIRA- project. Possible common interest could be on the nutritional status of vulnerable people who may

the worst nutrient adequacy and health. In addition, high consumers of supplements could be studied due to overdosing in nutrient intakes.

Food categories and the harmonization of European dietary studies are top priorities in EFSA's activities. So far, the European dietary data is collected from separate national dietary surveys carried out with different methods and entered into EFSA's Comprehensive Database. Due to methodological differences, the dietary data from the database should be used with caution (Merten et al. 2011). The NORDIRA project found that several food categories should be applied in reporting the results of food consumption which is confirming earlier results (de Neve et al. 2010). The food categorisation is the main issue in the risk assessment of harmful chemical substances that occur in specific food items depending on the origin of ingredients, processes applied and additives used during processing.

For quantitative estimation of food consumption, all Nordic countries have developed picture booklets for portion sizes to be used as aids in the assessment of amounts eaten. The pictures vary by country by layout, angles of viewing the portions and by alternatives. The Nordic Council of Ministers has published a report on standardized food portions, which included a total of 771 weighed food records from Denmark, Norway and Sweden in its analyses (Haraldsdóttir et al. 1998). For new food portions, the sizes should be determined by consumption distributions, where a small portion represents the 10th percentile, a medium portion the 50th percentile and the largest portion the 90th percentile of individuals. Further, good guidelines for producing portion size pictures are not available (Nelson & Haraldsdóttir 1998). However, Foster and co-workers (2006, 2008) have studied the applicability of food pictures as food consumption estimates among children and declare a need for further development on the area of portion size estimation. The development of photographs of food portions could be an useful theme for cooperation.

The calculation procedures used when converting the food consumption figures into nutrient intakes may also have an effect on the results. Currently, the precise description of fortified food items or dietary supplements and specification if the nutrients derived from them are included into the nutrient intake is needed. This information was not completely described in the Nordic reports. All Nordic countries apply the conversion factors specified for calculation procedures by Bergström (1994). In recipe calculation, yield factors related to moisture loss during food preparation are used and in nutrient intake assessment the retention of vitamins and minerals in the cooking processes are taken

into account. However, within nutrients, the definition may vary from country to country and the determination of each nutrient should be expressed exactly in the reports. This concerns carbohydrates, fibre, fatty acids and vitamers.

6.2 Aspects for nutritional recommendations

There are two types of nutrition recommendations: traditional nutrient recommendations, which are based mainly on physiological data on the requirements of different nutrients, and recommendations on energy distribution expressed as percentages of the total energy intake, which have a much wider and different background (NCM 2004). In addition, food-based dietary guidelines may also include recommendations for nutrients. In formulation of the recommendations, several different types of studies are used as background information in order to arrive at recommendations that are as reliable and science-based as possible. National dietary surveys are one important part of the evaluation of the implementation and adequacy of dietary and nutritional recommendations.

Historically, the main objective of the nutrition recommendations was to prevent deficiency disorders (NCM 2004). Several Nordic dietary surveys have shown that the mean intake of vitamins and minerals is in most cases sufficient in relation to the recommendations. Nevertheless, there are a number of exceptions, such as inadequate intake of vitamin D and iron. When inadequate intakes are detected, the recommendations can be altered and specified, as was done in Finland at the beginning of the year 2011. The intake of vitamin D may be insufficient in many groups, e.g. among small children and pregnant women, and that is why the recommendations concerning the usage of vitamin D supplements were altered. However, nowadays the main objective of the recommendations has shifted to maintaining good health and preventing major chronic diseases.

It would be useful to compare the subjects meeting dietary guidelines and study, if there are differences in the background factors between Nordic countries.

7. Main findings of the NORDIRA project

Individual food consumption data is applicable and necessary for risk assessment purposes. The flexibility of food consumption data is essential for various purposes in food safety issues and food-based risk assessment. It should be possible to aggregate food items in the calculated food consumption data in terms of the origin of food, processing and by other descriptors of food items. When carrying out the NORDIRA project, it was noticed that it is not easy to perform specific searches on subgroups.

The main food categories, such as fish and seafood, were identified for the Nordic countries in EFSA's food consumption database. With respect to subgroups of food consumption, such as whole-grain bread, there are problems in EFSA's food categories and in the current reports of Nordic dietary surveys. NORDIRA-project tested if the consumption of high-fibre bread, defined by fibre content (>6 g/100 g), can be identified. The test was completed in two of the Nordic countries which revealed the extra effort is hard to complete.

It was also found that the determination of similar subgroups is burdensome and demands categorization of single food items. The identification of single food items is also dependent on descriptors of food items in the dietary data. It is not certain whether all the information regarding the preparation of food items is recorded in the entered dataset. The Strategic Plan of EFSA (2009) and earlier pan-European studies (de Neve et al. 2010) confirm that coordination of data collection from various aspects of food safety is the key issue. Harmonized description of food consumption and occurrence data is the basic demand, but at the same time the data should enable sensitively analyzes for new risks. In this task, local activities may raise relevant aspects.

This report has focused on Nordic national dietary surveys and has included not only the latest published surveys but also information on forthcoming, as-yet unpublished data. The aim was to compare the design, implementation and results of these dietary surveys. Several earlier studies comparing the Nordic countries have stated that it is necessary to achieve the regional harmonization of dietary data collection and

general guidelines for the presentation of results. It was clearly noticed that tailored calculations are laborious and require much extra work.

The oldest surveys included in this report are the Norwegian surveys that were carried out in 2000 and 2001. The newest dietary surveys have collected data in 2010, 2011 and 2012 (e.g. Danskernas kostvaner 2012). Participation rates varied from 50% (in adults) to 83% (in children) in national dietary surveys. The methods varied from one 24-h recall to 7-day pre-coded food record and food frequency questionnaires. The calculation software and data entry soft used for entering dietary data into the study databases are national applications

Method development such as a web-based food diary could be tempting for adolescents. Experiences in design of new methodologies are encouraging (Birtoft-Jensen et al. 2012) and could be a theme for Nordic cooperation. As an example of common interests, further studies on the application of national dietary surveys could compare high consumers and non-consumers of food items fortified with vitamin D.

In conclusion, tasks in food-based risk assessment demand detailed food descriptors in consumption data and in occurrence data. In future tailored data analyses are also assumed necessary by current food safety aspects.

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Sammanfattning

Målet med NORDIRA-projektet var att skapa ett nätverk av nordiska experter inom livsmedelskonsumtionsforskning och livsmedelsbaserad riskbedömning. Gruppen bestod av experter inom dessa områden från alla fem nordiska länder. Tre möten hölls inom ramen för projektet. På dessa möten presenterades aktuella resultat och metodologiska erfarenheter av ländernas nationella kostundersökningar. Alla nordiska länder har genomfört nationella kostundersökningar under 2000-talet, och i de flesta länderna omspänner undersökningarna alla åldersgrupper. Alla nordiska länder har tillämpat uppgifterna om livsmedelskonsumtionen i sina bedömningar av intag av skadliga kemiska föreningar.

NORDIRA-gruppens samarbete gick bland annat ut på att utbyta erfarenheter om insamlingen av livsmedelskonsumtionsdata, presentera forskningsresultat om livsmedelskonsumtion och näringsintag samt tillämpa uppgifterna om livsmedelskonsumtion i riskbedömningar och riskkalkyler. Experterna representerade följande instanser inom forskning och förvaltning: Tekniska universitetet i Danmark DTU (Danmark), Institutet för hälsa och välfärd THL och Livsmedelssäkerhetsverket EVIRA (Finland), Islands universitet och Livsmedelsmyndigheten i Island (Island), Oslo universitet och Norska vetenskapskommittén för livsmedelssäkerhet VKM (Norge), Livsmedelsverket NFA (Sverige).

Expertgruppen samlade ihop uppgifter och nyckeltal om de nordiska undersökningarna om livsmedelskonsumtion, de mätmetoder som använts, de åldersgrupper som undersökts och deltagningsaktiviteten. Livsmedelskonsumtionen jämfördes länderna emellan i enlighet med det system för livsmedelsklassifikation som används i nationella rapporter. Denna rapport redogör för människornas näringsintag och presenterar exempel på olika fördelningar av näringsintag. NORDIRA-gruppen hade som mål att samla information om konsumtionen av sådana livsmedelsgrupper som är intressanta med tanke på näringsrekommendationerna. Detta delmål uppnåddes av Danmark och Finland. Även olika fördelningar av näringsintag presenteras för Danmarks och Finlands del.

På de årliga NORDIRA-mötena gick man igenom hur uppgifterna om livsmedelskonsumtion kan användas i livsmedelsbaserade riskbedömningar. Som diskussionsunderlag presenterades flera tillämpningsexempel, och denna rapport redogör för uppskattade intag av koffein, söt-

ningsmedel, konserveringsmedel, växtskyddsmedel, kvicksilver, perfluorföreningar, dioxiner, kadmium och heterocykliska aminer.

Denna TemaNord-rapport är ett sammandrag av föredragen från NORDIRA-expertgruppens möten, resultaten från den genomförda enkäten samt tankar och diskussioner som förts i samband med mötena och annan korrespondens under åren 2009–2012. Gruppens erfarenheter pekar på ett ökat behov av flexibel hantering av livsmedelskonsumtionsdata. Detta skulle möjliggöra olika datajämförelser mellan livsmedelskonsumtionen och förekomsten av kemiska ämnen. Att använda livsmedelskonsumtionsdata i exponeringsbedömningar är känsligt med tanke på definitionen av livsmedel och deras egenskaper och kan ofta genomföras från fall till fall.

Yhteenveto

NORDIRA-projektin tavoitteena oli koota yhteistyöhön pohjoismaisia asiantuntijoita ruoankäyttötutkimuksen ja elintarvikevälitteisen riskinarvioinnin teemoista. Ryhmän jäsenet edustivat näitä aloja viidestä pohjoismaasta. Projektin jäsenet kokoontuivat kolmeen kokoukseen, joissa esiteltiin ajankohtaisia tuloksia ja menetelmällisiä kokemuksia kansallisten ravitsemustutkimusten toteutuksessa. Kaikilla pohjoismailla on kansallisia ravitsemustutkimuksia 2000-luvulla ja useimmissa maissa tutkimukset kattavat eri ikäryhmät. Kaikki pohjoismaat ovat soveltaneet ruoankäyttötietoa haitallisten kemiallisten yhdisteiden saantiarvioissa.

NORDIRA-ryhmän työskentely sisälsi tiedonvaihtoa ruoankäyttötiedon keruun kokemuksista, ruoankäytön ja ravinnonsaannin tulosten esittämisestä, sekä ruoankäyttötiedon soveltamisesta riskinarvioinnissa ja riskitekijöiden laskentamalleissa. Asiantuntijat edustivat seuraavia tutkimuksen ja hallinnon tahoja: Tanskan Teknillinen Yliopisto DTU (Tanska), Terveyden ja hyvinvoinnin laitos THL ja Elintarviketurvallisuusvirasto EVIRA (Suomi), Islannin yliopisto ja Islannin Elintarvikeviranomainen (Islanti), Oslon yliopisto ja Norjan elintarviketurvallisuuden tieteellinen komitea VKM (Norja), Valtion Elintarvikevirasto NFA(Ruotsi).

Asiantuntijaryhmä kokosi tiedot ja tunnusluvut pohjoismaisista ruoankäyttötutkimuksista, ruoankäytön mittausmenetelmistä, tutkituista ikäryhmistä ja osallistumisaktiivisuudesta. Ruoankäyttöä verrattiin pohjoismaiden välillä kansallisissa raporteissa käytetyn ruoka- ja elintarvikeluokituksen mukaisesti. Tässä raportissa kuvataan ravinnonsaantia ja ja ravinnonsaannin jakaumista esitetään esimerkkejä.. NORDIRA-ryhmän tavoitteena oli kerätä tietoa ravitsemussuositusten kannalta mielenkiintoisten ruokaryhmien kulutuksesta. Tämä osatavoite onnistuttiin toteuttamaan Tanskassa ja Suomessa. Myös ravinnonsaannin jakaumat esitetään Tanskan ja Suomen osalta.

Ruoankäyttötiedon soveltamista elintarvikevälitteisessä riskinarvioinnissa esiteltiin vuosittaisissa NORDIRA-projektin kokouksissa. Keskustelun pohjaksi esiteltiin lukuisia sovellusesimerkkejä, ja niistä tässä raportissa esitellään kofeiinin, makeutusaineiden, säilöntäaineiden, kasvinsuojeluaineiden, elohopean, perfluoriyhdisteiden, dioksiinien, kadmiumin ja heterosyklisten amiinien saantiarviot.

Tämä TemaNord raportti on yhteenveto NORDIRA-asiantuntijaryhmän kokousten esityksistä, toteutetun kyselyn tuloksista ja kokouksissa ja viesteissä käydystä pohdinnasta vuosina 2009–2012. Ryhmän kokemukset korostavat tarvetta joustavaan ruoankäyttötiedon käsittelyyn. Tämä mahdollistaa erilaiset yhdistelyt ruoankäyttötietojen ja kemiallisten aineiden pitoisuustietojen välillä. Ruoankäyttötiedon soveltaminen altistusarvioissa on herkkä ruokien määrittelylle ja ominaisuuksien kuvaukselle ja usein toteutettavissa tapauskohtaisesti.

9. Appendices

9.1 App 1.The NORDIRA Questionnaire

9.1.1 The NORDIRA Questionnaire 1/2009

Background of dietary surveys and risk assessment in the Nordic Countries

1. Name of respondent (type in)
2. Institution of respondent and e-mail address (type in)
3. Country
4. Name of the National Dietary Survey
5. Institution responsible for the data collection of the National Dietary Survey
6. Funding of the National Dietary Survey (ministries, other public sources, private funding)
7. Institution responsible for the processing of the dietary data
8. Funding of the Risk assessment activities (ministries, other public sources, private funding)
9. Institution responsible for risk assessment in your country (if several institutions using the same Dietary Survey data for risk assessment purposes, please list of them and specify the areas of expertise)
10. Additional comments concerning the organisation of national dietary surveys and risk assessment activities in your country

Latest National Dietary Survey of your country

11. Name of the Survey and publications available (please indicate the references in paper/on the Internet)
12. Time (years) and place (e.g. home visits, health centre) of data collection
13. Population, sampling and response rate
14. Method of the food consumption data collection
    a. Estimated food records
    b. Weighed food records
    c. Dietary recall
    d. Dietary history

e. FFQ
f. WEB-based collection method
g. Other

15. Please describe the method used (number of days, pre-structured food record, open ended food record, picture booklet, number of pictures in the booklet, number of items in the FFQ, coverage of week-days etc.)

Describing the food intake

16. Background data collected of the food consumption (place of the meal, health status of the respondent, with whom eaten, other background data)
17. Method of describing the foods eaten
    a. Standardized interview method (e.g. EPIC soft interview)
    b. Day, structure of the day, meal, items at the meal, description of the item
    c. Other type of data collection process, please specify
18. If food records, were they checked at the return?
19. Training of the interviewers / those checking the food records?
20. If dietary recalls were used, please indicate the software used for data collection (please describe the method or provide a reference)
21. If dietary recalls were used, please indicate the software used for calculation of the intakes (please describe the method or provide a reference)
22. What kind of and how many food classification systems do you use in your reporting system? Please provide a list
23. Do you use the Langual system in describing the foods?
24. Do you have a computerized data collection software in use? Please describe
25. Do you have experience of the EPIC software in food consumption data collection in your country (in the national dietary survey or other dietary related surveys)?
26. What are the main challenges in your country in the area of food consumption data collection?
27. What are the main challenges in you country in the area of providing food consumption data for risk assessment purposes?

9.2 App 2. Dietary survey in Denmark

9.2.1 Danskernes kostvaner 2003–2008

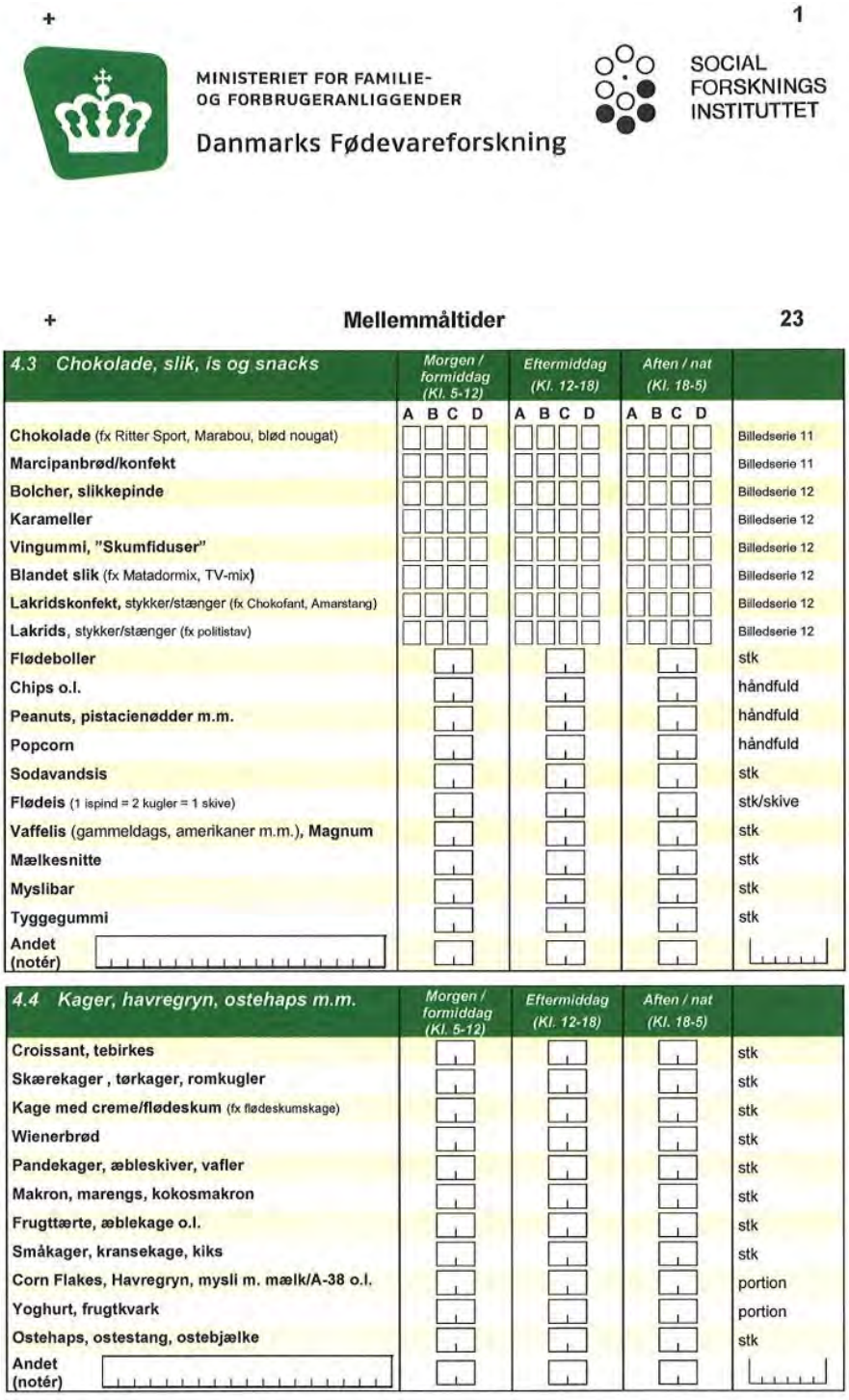
Study setting and dietary methods

This report, Dietary habits in Denmark 2003–2008, is based on data collected as a part of the Danish National Survey of Dietary Habits and Physical Activity (Pedersen et al. 2010). Previous reports are from years 2000–2002, 1995 and 1985. The survey was conducted by the National Food Institute (www.food.dtu.dk). The latest survey in 2003–2008 included 4431 individuals aged 4 to 75 years representative of Denmark with a participation rate of 53 percent. The survey contains questions on self-reported height and weight, but does not contain health examination.

Participants were asked to fill in a food record for seven consecutive days. The food record was a pre-coded (semi-closed) questionnaire structured by typical meal pattern. The participants answered categories for the most commonly consumed foods, dishes and drinks at each eating session (Figure A1).

If the food or drink consumed was not on a list, it was possible to note the type and amount eaten. The amount of foods eaten were given in a household measures. Respondents had a possibility to use a picture book of portion sizes. In a calculation of the nutrition content of diets was a program called GIES (General Intake Estimation System) used. Before the participants started to record their dietary habits and physical activity, they underwent a face-to-face interview about their background. The interviewers conduct the interview in the participant´s home and return after the recording period has ended to collect the filled-in dietary records.

Figure A1. A page for snacks in the Danish pre-coded food diary



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MINISTERIET FOR FAMILIE- OG FORBRUGERANLIGGENDER

Danmarks Fødevareforskning

SOCIAL FORSKNINGS INSTITUTTET

\+ **Mellemmåltider** 23

4.3 Chokolade, slik, is og snacks	Morgen / formiddag (Kl. 5-12)				Eftermiddag (Kl. 12-18)				Aften / nat (Kl. 18-5)				
	A	B	C	D	A	B	C	D	A	B	C	D	
Chokolade (fx Ritter Sport, Marabou, blød nougat)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Billedserie 11
Marcipanbrød/konfekt	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Billedserie 11
Bolcher, slikkepinde	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Billedserie 12
Karameller	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Billedserie 12
Vingummi, "Skumfiduser"	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Billedserie 12
Blandet slik (fx Matadormix, TV-mix)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Billedserie 12
Lakridskonfekt, stykker/stænger (fx Chokofant, Amarstang)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Billedserie 12
Lakrids, stykker/stænger (fx politistav)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Billedserie 12
Flødeboller	⌐				⌐				⌐				stk
Chips o.l.	⌐				⌐				⌐				håndfuld
Peanuts, pistacienødder m.m.	⌐				⌐				⌐				håndfuld
Popcorn	⌐				⌐				⌐				håndfuld
Sodavandsis	⌐				⌐				⌐				stk
Flødeis (1 ispind = 2 kugler = 1 skive)	⌐				⌐				⌐				stk/skive
Vaffelis (gammeldags, amerikaner m.m.), **Magnum**	⌐				⌐				⌐				stk
Mælkesnitte	⌐				⌐				⌐				stk
Myslibar	⌐				⌐				⌐				stk
Tyggegummi	⌐				⌐				⌐				stk
Andet (notér)	⌐				⌐				⌐				⌐

4.4 Kager, havregryn, ostehaps m.m.	Morgen / formiddag (Kl. 5-12)	Eftermiddag (Kl. 12-18)	Aften / nat (Kl. 18-5)	
Croissant, tebirkes	⌐	⌐	⌐	stk
Skærekager , tørkager, romkugler	⌐	⌐	⌐	stk
Kage med creme/flødeskum (fx flødeskumskage)	⌐	⌐	⌐	stk
Wienerbrød	⌐	⌐	⌐	stk
Pandekager, æbleskiver, vafler	⌐	⌐	⌐	stk
Makron, marengs, kokosmakron	⌐	⌐	⌐	stk
Frugttærte, æblekage o.l.	⌐	⌐	⌐	stk
Småkager, kransekage, kiks	⌐	⌐	⌐	stk
Corn Flakes, Havregryn, mysli m. mælk/A-38 o.l.	⌐	⌐	⌐	portion
Yoghurt, frugtkvark	⌐	⌐	⌐	portion
Ostehaps, ostestang, ostebjælke	⌐	⌐	⌐	stk
Andet (notér)	⌐	⌐	⌐	⌐

Food consumption and nutrient intakes

The consumption of fruit, vegetables and tap water has increased while consumption of sugar sweetened soft drinks has decreased compared to the former Danish survey in 2000–2002. Still the consumption of fruit and vegetables did not reach the recommended amount. The consumption of high-fat cheese, sugar and candies has also increased and that of potatoes has decreased.

For the adult population, the average intake of fat, protein and carbohydrates contributed 35, 15 and 50 percent, respectively, from daily energy (E%). The corresponding figures for children (under 18 years) were 33, 15 and 53 E%. The intake of saturated and trans fatty acids was high, from daily energy adults derived from those 16 E% and children 15 E% which is more than recommended 10 E%. Half of the saturated fatty acids were derived from milk and milk products. The distribution of energy intake from alcohol among adults is highly skewed and it was on average around 6 E%.

More than half of the children (aged 4–14) and about fourth of the adults consumed more added sugar than it is recommended (10 E%). For children the average intake of added sugar contributed 12 % and for adults 9 % of daily energy. The intake of salt was 7.3 and 9.8 g/day for women and men, respectively, which also exceeded the recommended levels. In contrary, the intake of vitamin D was too low and among many fertile women the intake of iron was insufficient. Also the intake of dietary fibre was below the recommended 25–35 g/day.

Danish diet and physical activity 2011–2013

Denmark started a new data collection in the middle of 2011.This survey will last for years and includes 3700 participants aged 4–75 years.

The new survey includes both measured and self reported height and weight as well as measured waist circumference. Physical activity is measured by pedometer and the survey will be the largest European survey on a representative sample of the population. The survey uses still 7 day estimated record but the booklet with pictures has increased to 42 pictures to make it easier for participant to find pictures of what they have been eating

9.3 App 3. Dietary surveys in Finland

9.3.1 National dietary survey FINDIET 2007 in adults

Study setting and dietary methods

FINDIET2007 (Paturi et al. 2008) is a part of the national health survey FINRISK2007, a study done every five years that monitors chronic disease risk factors in Finland by the National Institute for Health and Welfare (THL; former KTL, Kansanterveyslaitos; www.thl.fi). A random sample of adults aged 25–74 years, stratified by sex, region and 10-year age groups, was drawn from the population register in five different regions. The FINRISK population sample is thus representative sample from these regions. The study was conducted in spring 2007. Subjects were invited to a health examination which included a body weight measurement and a blood sample at the local health care centre. The invitation sent to the potential participants included a questionnaire covering such personal background information as social status, health status, and habitual food choices. One third of subjects from the national FINRISK health survey were invited to participate in the FINDIET 2007 survey. For the FINDIET2007 dietary data was collected for 2039 adults with a participation rate of 63%.

Dietary interview was completed face-to-face by computerized 48 hour dietary recall interview that was carried out by trained nutritionists. The interview covered the diet over the 48 hours prior to interview. It began by asking about meals eaten the previous day and continued by inquiring into meals taken on the day before yesterday. Identification of each eating event was principally based on the name of the eating occasion which was given to it by the subject. The interviewer selected the meal name from the following alternatives: breakfast, lunch, dinner, drink, evening snack, other snack and other eating event. Daily aggregated food consumption and nutrient intake were calculated by in-house software which uses the Finnish food composition database. For food consumption, and energy and nutrient intake, the mean intake over two days was calculated.

In addition to dietary interviews half of the respondents were asked to fill in a 3-day food record with the help of a picture book of food portions. Altogether 912 acceptable food records were obtained from the first round and 606 from the second one (Paturi et al. 2008). The results from food diaries were used in calculation of intake distributions. The consumption of branded food items was collected by 5-day food brand diary among another half of the participants in the dietary survey

(Hirvonen et al. 2011). The brand food information was used in the assessment of vitamin and mineral intakes from fortified foods.

Food consumption and nutrient intakes

The FINDIET report mainly presented food consumption for the working age group (25–64-year olds) and the elderly (65–74-year olds). According to the survey, an adult working Finnish person had, on average, six eating occasions per day. Main meals were the most important source of energy among the working age adults. Women had more snacks but less drinks per day than men and they tended to eat more often at worksite canteen (26% vs. 21%). The 25–64-year olds tended to consume more yoghurt, hard cheese and sweets than the elderly who in turn consumed more porridge and low-fat spreads.

Among the whole sample, 33% of men and 52% of women took food supplements. However, the usage was badly targeted and those who took supplements had already higher intake of vitamins and minerals that those who did not use supplements. In most cases the food supplementations was unnecessary because intake of vitamins and minerals from food was sufficient.

The percentage contribution of fat to the total energy intake was 33 E% in men and 31 E% in women. The respective percentages for saturated fatty acids were 13 E% and 12 E% which is more than is recommended. Most of the saturated fat consumed was so called hidden fat derived from for example milk products and bakery products. Energy intake from carbohydrates was on average lower than recommended 55 E% but energy intake from protein fell between the recommended 10–20 E%. Salt intake was higher than recommended and the intake of folate and vitamin D was below the recommended levels. The main sources of vitamin D were fish, dietary fats and milk products and that of folate were cereal products, vegetables, fruit and berries. Women's diet contained more protein, dietary fibre and sucrose compared to men's. Women also consumed more fruits and vegetables.

9.3.2 The diet of secondary school pupils 2007–2008

Study setting and dietary methods

The dietary survey studied the diet of Finnish 7th and 8th grade secondary school pupils, and especially the school-based eating (Hoppu et al. 2008, Hoppu et al. 2010a). The study was carried out during the academic year 2007–2008. Participants were from 12 secondary schools including 77 classes located in three different towns. In addition to cross-sectional

design which aimed to estimate the baseline situation, this study included an intervention that aimed to improve the food habits of these children. There were 726 pupils that completed the study in 2007.

Questionnaires were sent home to the pupils and their guardians. The questionnaire included questions about family, general well-being, physical activity and food habits. Dietary interviews and measurements (weight, height, waist circumference and blood pressure) were made at school by a dietitian and a research nurse. The 48 hour dietary interview was carried out for around 300 of the pupils.

Food consumption and nutrient intakes at baseline

At baseline, 40% of the girls and 28% of the boys consumed fresh vegetables every day. According to the guardians, less than half of the pupils had the possibility to consume fresh vegetables daily at their homes. About three quarters of the pupils had a school lunch every day. Approximately one quarter of the girls and one-third of the boys reported having all the different parts of the school lunch, which included the main meal, salad, bread and milk. Around 20% of the daily energy intake was derived from the school lunch, which does not reach the recommended level of 33%. However, the school lunch was still nutritionally superior to the other daily meals. Around 40% of the daily energy intake among the pupils was derived from snacks. The most commonly consumed snacks during school time were sweets or chocolates, bread, cereal bars, fruit and sugary soft drinks.

The energy intake from food was low which is partly explained by the underreporting. The energy distribution among energy nutrients was satisfactory and reached the nationally recommended level. However, there is still room for improvement in the quality of fats and carbohydrates. The energy intake from saturated fatty acids was 12 E% among both genders. The proportion of energy derived from sugar was higher, and the intake of fibre lower than recommended. In addition, the intakes of vitamin A, vitamin D, folate and iron fell below the recommended levels.

Results from the intervention

The aim of the intervention was to increase consumption of fruit and vegetables and intake of fibre, and decrease intake of sugar (Hoppu et al. 2010b). Intervention procedures were introduced during an academic year. The success of the intervention was measured by the increasing availability of soft bread at school lunch and offering healthier snacks. The proportion of energy derived from sugar decreased among the pupils from the intervention schools. Girls in the intervention schools consumed rye bread more frequently. However, the intake of fibre as a

whole did not increase. Intervention school girls also consumed fewer sweets during school hours. Pupils from the intervention schools found the school lunch "better tasting" more frequently than those in the control schools. Most of the pupils in the intervention schools also felt that having school lunch enhances their energy levels.

The most effective way to influence young people's eating habits is to improve the school ethos and the environment so that it encourages a healthy lifestyle and facilitates healthy eating. A supportive environment can include rules and regulations, such as a ban on leaving the school area during school time, and an active participation from teachers in school meals. Unhealthy snacks should not be available at the school premises, and should instead be replaced by a larger variety of healthy snack options. During school meals, the supply of soft bread, vegetables and fruit should be increased, and young people should be encouraged to eat all the different parts of the school meal. It is the responsibility of the parents, and the adults at school, to facilitate healthier choices both at school and at home.

9.3.3 The Diet of Finnish Preschoolers

Study setting and dietary methods

The dietary data of healthy pre-school children from the Type 1 Diabetes Prediction and Prevention (DIPP) Nutrition Study was reported (Kyttälä et al. 2008). The DIPP Study is a long-term population based follow-up study which has children with a risk of type 1 diabetes as participants conducted by the National Institute for Health and Welfare (THL). Information on food consumption and food supplements usage was collected by food diaries from children living in two different regions in Finland. The participants were born between the years 1998–2003 and the food diaries covered in this subsample were collected between the years 2003–2005. The aim of this study was to get information about the diet of healthy children aged 0- to 6- years. Altogether there were 2535 food records included in this study.

Families received a background information form, partly structured dietary questionnaire and a 3-day food record to fill in. Background information included for example the age of mothers, the educational level of parents and the amount of siblings. Food records were asked to include two weekdays and one weekend day. Food records were filled partly at the day care and at home. Those children's food records that went to a day care were filled in by carers.

A trained research nurse or a research doctor checked the filled forms together with the parents and when necessary, asked about missing information. The data entry of food records was performed by nutrition researchers and it was done as detailed as possible. Daily aggregated food consumption and nutrient intake were calculated by in-house software which uses the Finnish food composition database. Receipts in the data recording program were altered when necessary.

Food consumption and nutrient intakes

Based on the findings from this Finnish study on children, the mean duration of exclusive breastfeeding was continued, on average, up to the age of seven months. Most of the babies (80%) were given supplementary milk while still at their delivery hospital. Low education level, young maternal age and smoking were associated with a shorter duration of breastfeeding.

The consumption of fresh vegetables, fruits and berries were low among the 1- to 6 -year-old children, as was the consumption of fish dishes and the use of fat spreads. Cereal and milk products and meat dishes on the other hand were consumed in greater amounts. The consumption of sugar-containing juices, chocolates and sweets increased after the age of two years. Diets of 1-year-olds contained large amounts of industrial baby foods. The quality of the children's diet tended to decline after starting to take part in family meals.

During weekdays, the diet of children was more balanced and closer to the recommendations when they were in day care compared to children cared at home. All in all, diets were closer to recommendations on weekdays. High maternal age, high educational level of parents, small family size and residence in the Tampere Region were associated with healthier diet in children. Based on the study, the diet of Finnish preschool aged children is good by international standards, but some aspects of its quality should be given more attention and improved.

The intake of sucrose and saturated fatty acids was higher than levels suggested by the Finnish Nutrition Recommendations among toddlers and preschoolers (2- to 6-year-olds) and the intake of polyunsaturated fatty acids was lower than recommended. The important sources of sucrose were juices and yoghurt, which contain a lot of 'hidden' sugar. The intake of vitamin D was inadequate among most of the cases. Also the intakes of vitamin E and iron fell below the recommended levels.

9.4 App 4. Dietary survey in Iceland

9.4.1 Hvad borda Islendingar?

Study setting and dietary methods

The Icelandic dietary survey, The Diet of Icelanders, was organized and carried out by the Icelandic Nutrition Council (now called the Public Health Institute, www.lydheilsustod.is) in collaboration with the Social Science Institute at the University of Iceland (Steingrimsdóttir et al. 2002). The survey was carried out in 2002 in two periods, February to May and August to November. A random sample of 1934 people aged 15 to 80 years was drawn from the national population register. The participation rate was 70.6% and thus the final number of participants was 1399. The previous national dietary survey had been done in the year 1990.

In the data collection 24-hour recall via telephone was used (Steingrimsdóttir et al. 2002). The participants received also a picture booklet of portion sizes to help the estimation of food portions. The booklet had photos of portion sizes of 49 dishes or foods. In addition to 24-hour recall participants were asked to fill in a FFQ which included an average consumption of foods during the last three months and the supplements used. Participants were also asked about their social background and lifestyle. All data were directly entered into an interview-based program called ICEFOOD, which had been developed for this study. The data used was based on two different databases: the Icelandic Nutrition Council recipe database and the Icelandic Food Composition Database (ISGEM).

Food consumption

When comparing the food consumption to the situation in 1990 has the consumption of milk, coffee and potato decreased in Iceland. On the contrary, the consumption of vegetables, fruit, pizza and candy, water and soft drinks has increased.

Energy and nutrient intake

The average energy intake among Icelandic men was 10.6 MJ and among women 7.5 MJ. Intake of protein was quite high, 18 E%. Fat intake has decreased during past years from 41 E% to 35 E%. Intake of saturated and trans fatty acids has also decreased and was now 16 E%, although it still was above recommendations. The energy gained from added sugar was 11 E%, which was much higher when viewing only younger men

and women (21 E% and 15 E%). Intake of vitamin D was low in all age groups and intake of iron, calcium and iodine was low in young women.

9.4.2 The Diet of Icelanders 2010–2011

The Public Health Institute of Iceland is presently collecting data for the next national dietary survey in which the Unit for Nutrition Research is involved in certain aspects. The survey is based on same methods as the previous survey except the 24-hour recall is now done twice instead of only once. Interviews are done at least one week apart from each other. In addition, participants are asked to fill in an FFQ on the rarely eaten foods. For the purpose of this study were the recipe database and ISGEM updated. The results of the study are published in spring 2012.

9.5 App 5. Dietary survey in Norway

9.5.1 UNGKOST-2000

Study setting and dietary methods

UNGKOST-2000 is a nutrition survey that has been done in tandem with Norwegian directorate of Health (www.helsedirektoratet.no), Norwegian Food Safety Authority and University of Oslo (Institute for Nutrition Research). Participants were 4-year-old children representative of Norway. (Pollestad et al. 2002). The data collection among the 4-year-olds were conducted in August-December 2001. A total of 391 children completed the survey with a response rate of 53%. There were 60% of the children at a full time day care during the day time and 10% were nurtured at home.

Parents were asked to fill in a four-day precoded food diary. The 18-page recoded food diary had lists of 277 food items (twenty-eight drinks, twenty-four dishes and 255 food items) grouped together according to the typical Norwegian meal pattern (Øverby et al. 2004). Each food group was supplemented with open-ended alternatives. The design of the precoded food diary was similar to a cross-table with food listed on the left and time span across the top. Food amounts in the precoded food diary were presented in household units (e.g. glasses, pieces or tablespoons) or as portions estimated from photographs. Along with the precoded food diary, each participant received a photographic booklet that contained thirteen series of colour photographs, each with four different photographs ranging from small to large portion sizes (Lillegaard et al.

2005). Participants indicated an eating event by filling in how many units they had eaten of each food item in the correct time span.

The pre-coded food diary was scanned using the Teleform program, version 6.0 (Datascan, Oslo, Norway). Daily intake of energy was computed using the food database and software system (KBS, version 4.7, 2004) developed at the Department of Nutrition, University of Oslo. The food database is based mainly on the official food composition table.
In addition to pre-coded food diary parents were asked to fill in a background questionnaire that included questions about the child's weight, height, parents´ education, day care, time used on TV and computer and different kind of questions about food habits.

Food consumption and nutrient intakes

The consumption of fruit and vegetables among Norwegian children did not reach the recommended level. The average usage was 225 g/day when only 12% of the girls and 8% of the boys exceeded the recommended 400 g/day.

About 90% of the children ate breakfast every day and between 70 to 80% of them ate lunch and dinner daily. Evening meal was in daily schedule only among 60–70% of the respondents. Lunch was the meal that was typically eaten outside the children's homes. Over half of the children ate lunch five times a week at places such as a day care or a park.

The energy intake distribution between energy nutrients in children was not satisfactory. The average of 32 E% was gained from fat, 14 E% from saturated fatty acids and 15 E% from added sugars. The representative recommended amounts are 30, 10 and 10 E%. The most important sources of fat were butter, margarine, oil, milk products, meat and cakes. Sugar was consumed usually in a form of juice, soft drinks, added sugar, sweets, cakes, and yoghurt. The intake of fat and added sugar was significantly lower among boys that had at least one parent with a higher but also with a lower degree. Among girls the level of added sugar intake was significantly lower when their mother had a higher degree or a low degree.

The most popular supplements were multi-vitamin supplement and cod liver oil (vitamin D supplement). A bit more than a third of the girls and almost a half of the boys did not use supplements at all.

9.5.2 NORKOST 3

Norwegian Directorate of Health, Norwegian Food Safety Authority and University of Oslo have completed data collection for the national dietary survey, NORKOST 3, in summer 2011. This survey will provide data that can be used for evaluating the Norwegian diet in relation to dietary recommendations, assessing the intake of nutrients and contaminants and assessing the risk for intake of contaminants.There were 5000 men and women aged 18–70 years that were asked to participate in the survey. Information letter was sent them via mail and recruiting was done via telephone.

The dietary method used was 24-hour recalls that was conducted twice with at least 4 weeks between the interviews. After completing the 24-h recalls the participants were asked to fill in a food propensity questionnaire. This was a questionnaire with only frequency questions and no questions regarding amounts or portion sizes. Foods eaten were coded directly as stated in the food database. Those of who completed the questionnaire took automatically part in a lottery in which every 25th participant won 3000Nkr (about 400€).

9.5.3 The Norwegian Fish- and Game study

The aim of the Norwegian Fish- and Game (NFG) Study is to obtain information about the levels of dietary intake of environmental contaminants in Norwegian population. The main focus is on mercury, cadmium, PCB and dioxin. The NFG study is a three-stage survey (stages A, B and C).

Part A was national survey of consumption frequencies relating to foods considered to contain potentially high levels of environmental contaminants. The food consumption data was collected through qualitative food questionnaire by mail. Part B was a regional survey in 27 selected inland and coastal municipalities with good access to hunting and fishing. The goal was to identify individuals with high intakes of foods with potentially high levels of heavy metals and persistent organic pollutants. Te questionnaire used in part B was more detailed than the one use in part A, and it included a questionnaire that covered the consumption of different freshwater and saltwater species, fish liver, crustaceans, seagull eggs and game. Part C investigated in-depth a subpopulation derived from part B and included persons with an estimated high intake of pollutants from food. The aim was to carry out exposure assessment on people who are high consumers of foods that may contain high levels of environmental contaminants. Dietary exposure was assessed using a 12-page semi-quantitative FFQ consisting of 340 ques-

tions adapted to Norwegian food traditions. The used FFQ covered consumption over the last 12 months. The food frequencies were converted into consumption (g/day) by multiplying by standard, gender specific portion sizes.

9.6 App 6. Dietary surveys in Sweden

9.6.1 Livsmedels- och näringsintag bland barn I Sverige

Study setting and dietary methods

Swedish national food survey, Dietary Intake Among Children in Sweden, was conducted by the National Food Administration (www.slv.se). It was carried out in 2003 on 4-year-old children and school children on 2nd and 5th grade (Enghardt Barbieri et al. 2006). Children aged 4 years were randomly sampled from stratified sample of municipalities representative of Sweden and out of 924 children 590 fulfilled the survey. School children were sampled on the basis of school classes. There were 889 children out of 1209 in grade 2 and 1016 out of 1290 in grade 5 who fulfilled the survey. Each family taking part in the survey received a gift voucher of 200Skr (about 22€).

The method used was an open and estimated food diary over four consecutive days. Those children who were able to fill the diary on their own did it themselves and others were helped by their parents or carers. Portion sizes were estimated with the help of a picture booklet. Time and place of eating, fat content, mode of preparation, certain additives and brand name was also asked to fill in. An optically readable questionnaire contained questions about height, weight, parents´ education and profession, ethnic background and regional residence.

Coding, checking and recording of the content of the food diaries were made by personnel from Swedish National Food Administration. The calculation of the food, nutrition and energy intake was made with the help of nutrition calculation program MATs which uses the nutrition data information from Swedish National Food Administration's food database. This database was completed with supplements and with foods/dishes when necessary.

Food consumption and nutrient intakes

The fruit and vegetable intake was about half of the recommended amount of 400 gram per day for all the age groups. The children consumed fish 1–2 times per week and sausages 2–3 times per week. One

meal of sausage would be recommendable to replace with a fish dish, which would improve the quality of fatty acid intake.

Approximately 25% of the consumed daily energy originated from unhealthy food choices like soft drinks, sweets and desserts. The children consumed sweets an average of 3–5 times a week but 13% consumed sweets daily. Eating of buns, cakes and biscuits was almost equally frequent as that of sweets. The children drank an average of 200 ml soft drinks every day and 10% of school children drank 500 ml or more of soft drinks daily.

Children to parents with a university education consumed more fruits and vegetable and had a diet with a slightly higher nutrient density. Children with an ethnic background ate more fruits and vegetables but consumed less milk. In addition, children with a high BMI consumed more milk products and obese children's diet contained less carbohydrates and more protein than that of children with a normal weight.

The average energy intake was 6.3 MJ per day, 7.6 MJ and 7.4 for 4 year olds, 2nd graders and 5th graders, respectively. For the 4 year olds the reported average energy intake was 108% of the calculated reference value but for the children in grade 2 it was 81%. For the children in grade 5 were calculations made for a moderate and for a low physical activity level and the reported energy intake was thus 76% and 86% of the calculated reference value. About one fifth of the children were overweight of which 1 to 4% was obese.

The distribution of energy between fat, carbohydrates and protein in children's diet was satisfactory but the quality of fat and carbohydrates were not. The intake of sugar such as sucrose and monosaccharide (13–15E%) and saturated fat (14E%) were too high as well as the intake of salt. The salt intake was almost twice the recommended amount (5–7 gram) and was thus equivalent to the level of intake of adults. The major sources of sugar were e.g. soft drinks, sweets, flavoured dairy products and biscuits. The amount of polyunsaturated fatty acids, fibre and vitamin D in their diets were inadequate.

9.6.2 Riksmaten adults 2010–11 and other upcoming publications

Riksmaten adults 2010–11 is the third national food survey in Sweden. In Riksmaten Adults 2010–11 the invited sample was representative of the Swedish population and stratified on sex, age group (18–30 years, 30–44 years, 45–64 years and 65–80 years) and region. The survey was

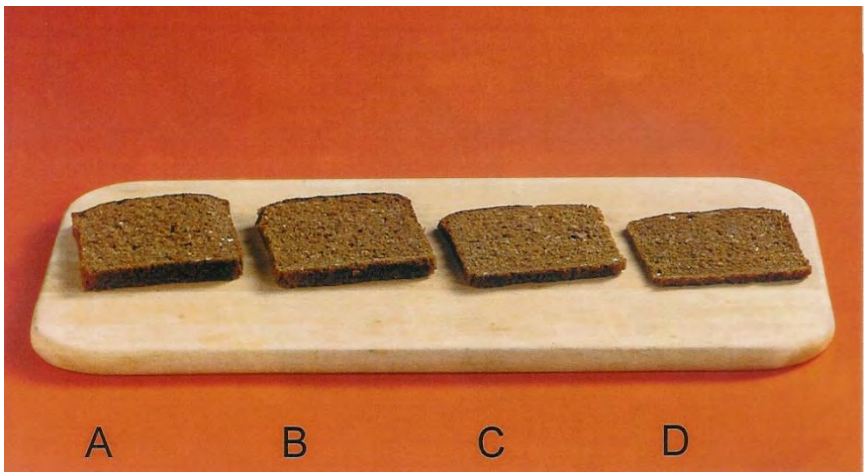
carried out between May 2010 and July 2011 and 1005 women and 792 men participated. The participation rate was 36% in the dietary survey.

Dietary intakes were recorded in an internet-based food diary for four consecutive days. The internet application contains 1900 food items and dishes. A printed portion guide, household measures, numbers and grams were used to estimate the amounts eaten. The application (version 04.1) is linked to the food composition database (Livsmedelsdatabasen, version Riksmaten adults 2010–11) held at the National Food Agency. All food items and dishes are linked to one main food group (dishes are intact) and to one or more composite food groups (dishes are broken into ingredients). After the participants had registered what they had eaten they received direct feedback on nutrient intakes via the web page. Participants had the choice to register what they had eaten via the telephone also.

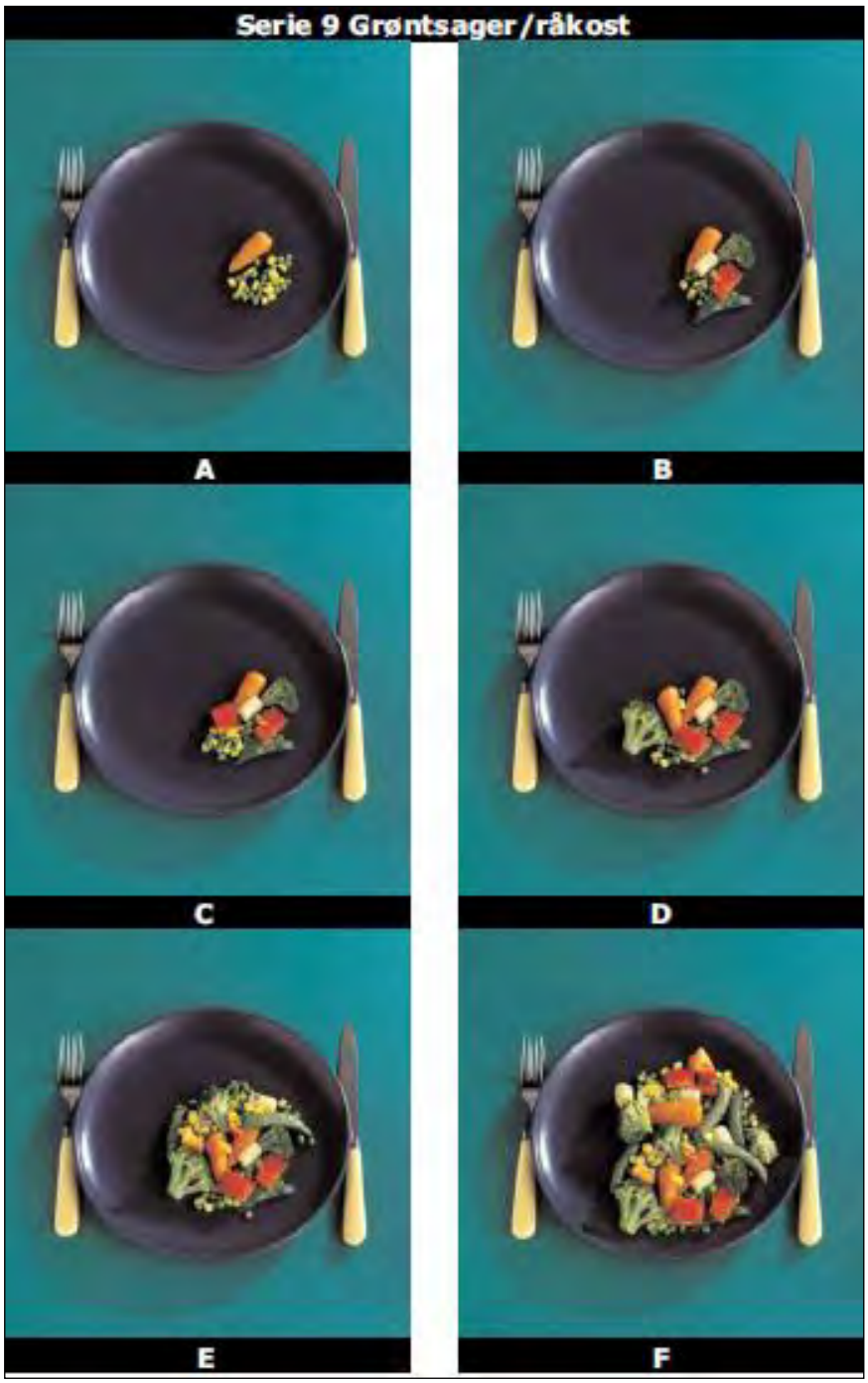
In addition to the dietary survey, Riksmaten adults 2010–11 included also a questionnaire with questions about their work, leisure time, education and food habits. In addition to the food diary and the questionnaire blood and urine samples were taken from a subgroup. The results will be published during 2012.

9.7 App 7. Examples of pictures of food portions in booklets

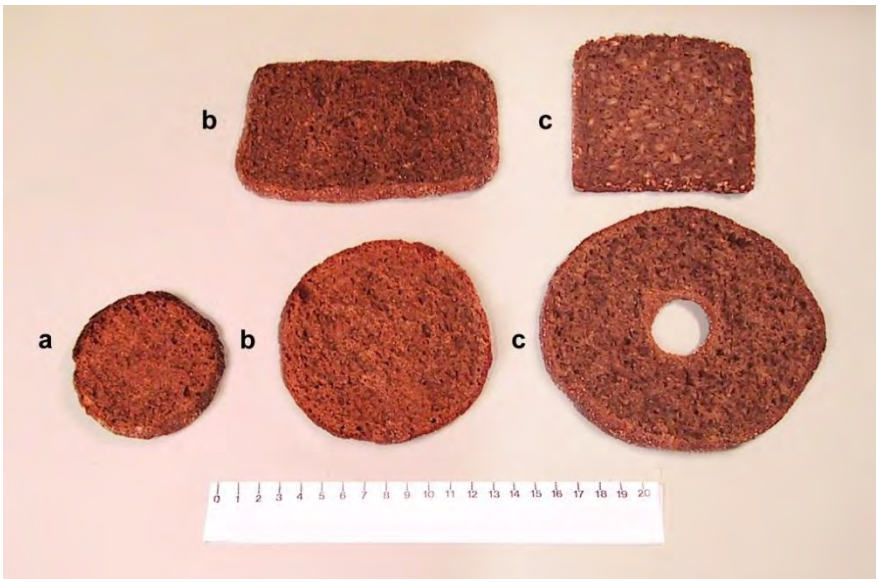
Picture A1. An example of bread slices in Danish picture booklet (The Danish National survey of diet and physical activity 2005–08)



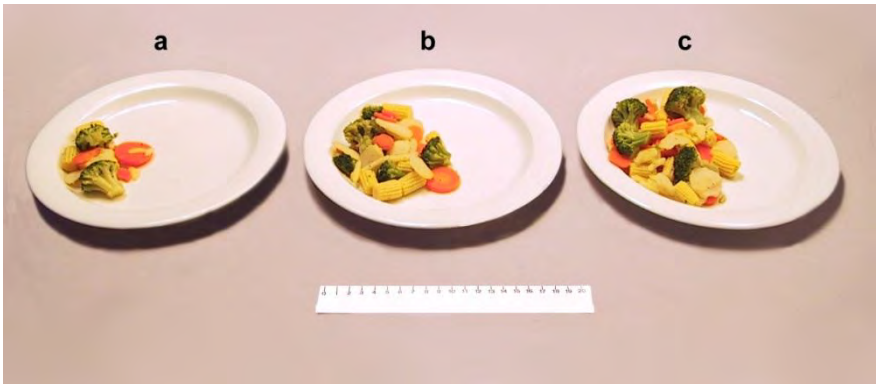
Picture A2. An example of portion sizes of vegetables in Danish picture booklet (The Danish National survey of diet and physical activity 2005-08)



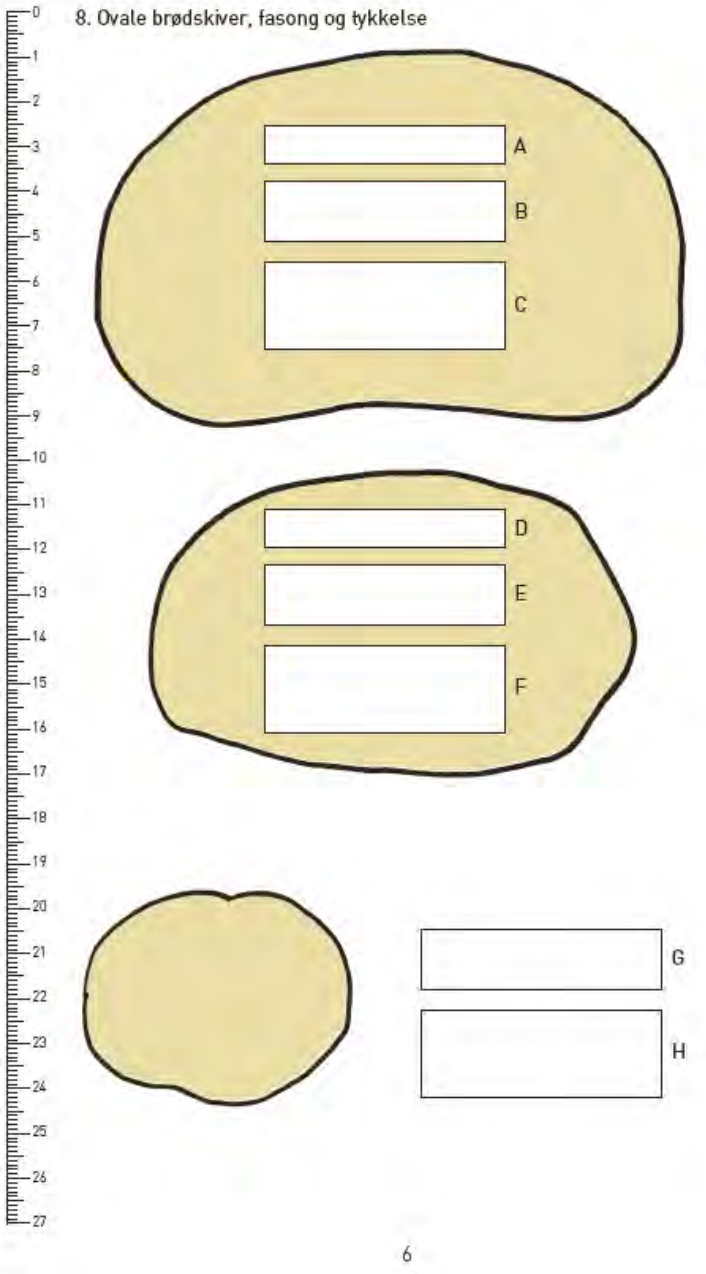
Picture A3. An example of bread slices in a Finnish picture booklet (Paturi et al. 2006)



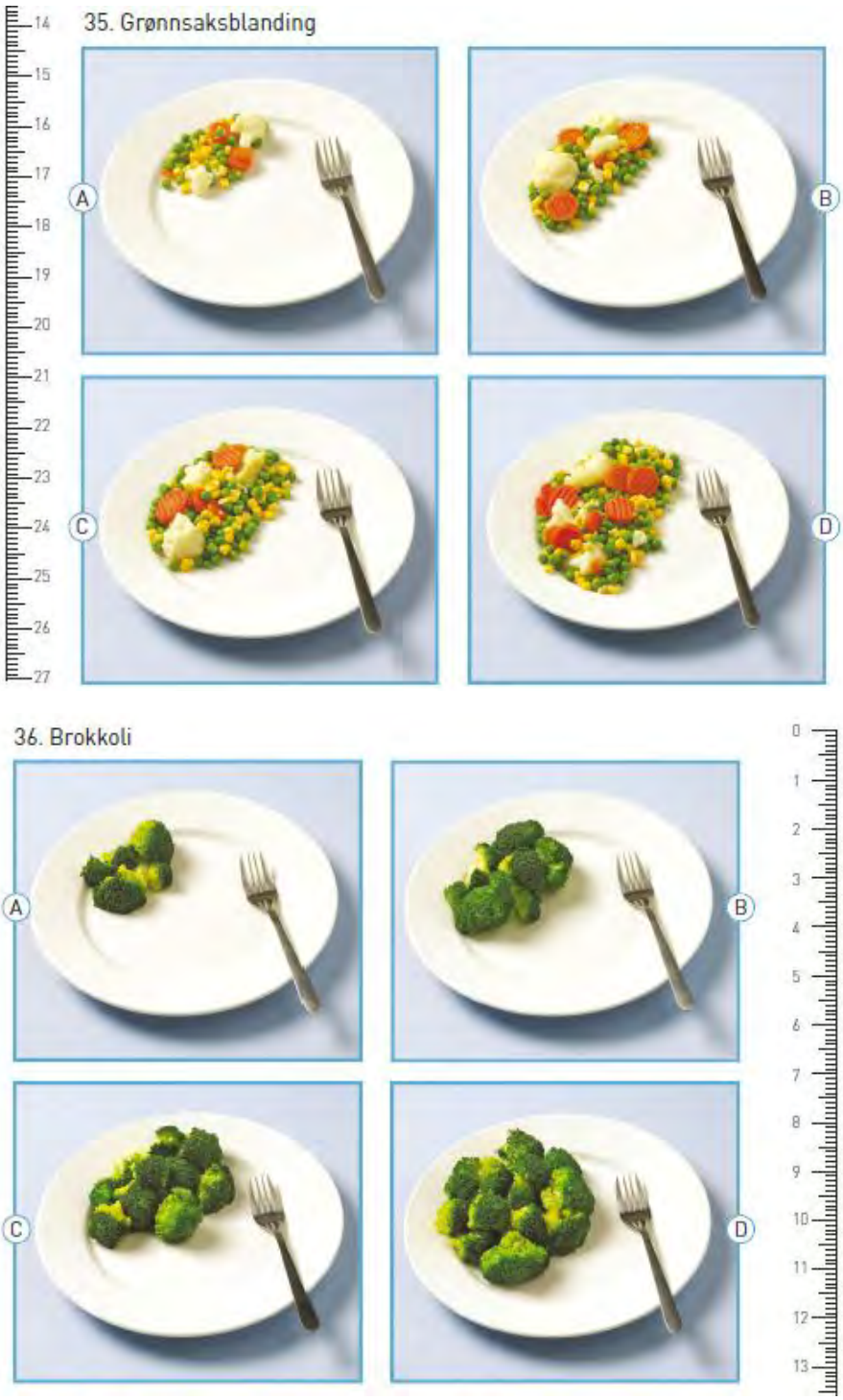
Picture A4. An example of portion sizes of vegetables in a Finnish picture booklet (Paturi et al. 2006)



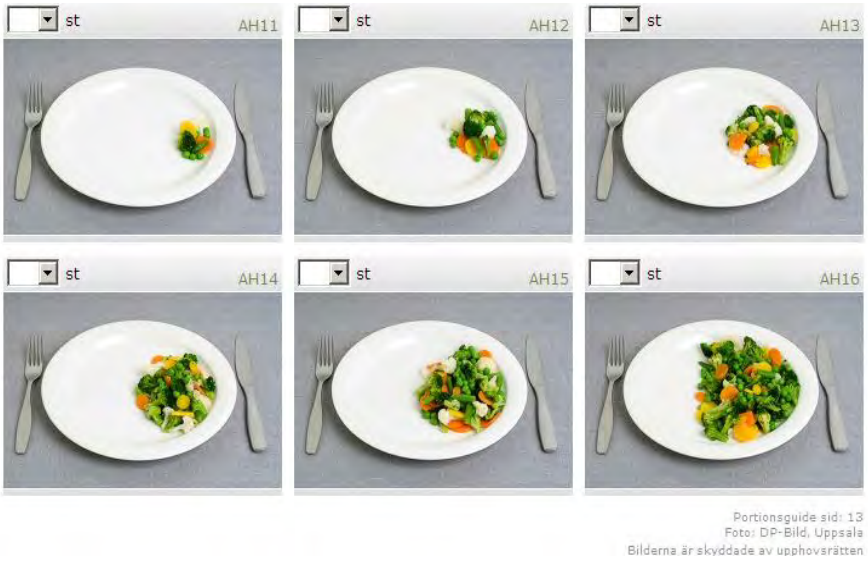
Picture A5. An example of bread slices in Norwegian picture booklet (Øverby & Andersen 2002)

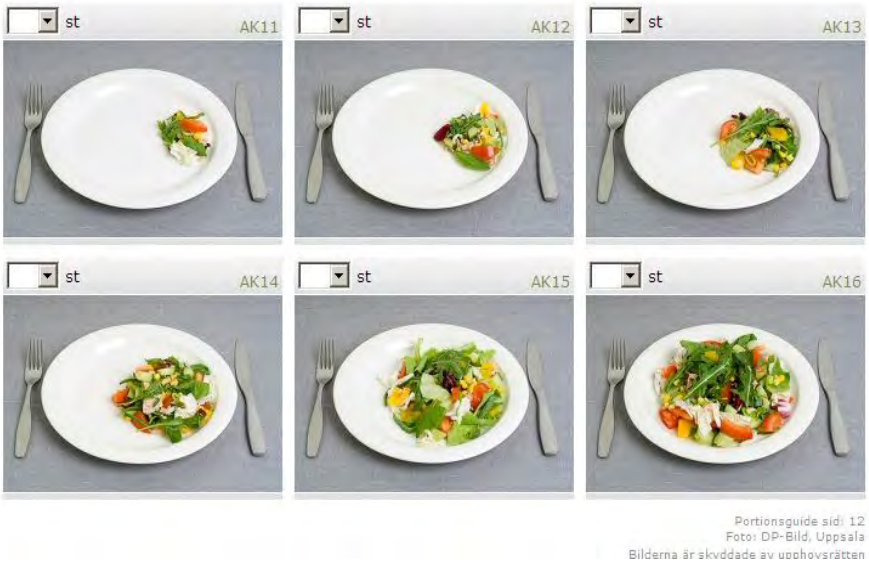


Picture A6. An example of portion sizes of vegetables in Norwegian picture booklet (Øverby & Andersen 2002)



Picture A7. An example of portion sizes of vegetables in Swedish picture booklet (Livsmedelsverket 2010)





9.8 App 8. Tables A1–A15

Table A1. Consumption of beverages, milk, bread and vegetables among Danish boys and girls13–15 y

Secondary school	Gender	Consumer proportion (%)	Daily use g/day	Std g	g/10 MJ	Std g
Beverages, with sugar	1	92	395	342	382	304
	2	89	242	210	312	257
Beverages, artificially sweetened	1	33	78	171	80	201
	2	44	79	160	110	232
Low-fat milk	1	45	105	195	109	204
	2	52	96	151	121	192
Low-fat sour milk	1	53	20	41	22	44
	2	58	18	33	24	44
High-fibre or whole-grain bread	1	94	64	58	66	60
	2	96	47	41	60	47
Vegetables	1	100	137	87	141	114
	2	100	124	75	161	95

[1]Gender: 1=boys (n=190), 2=girls(n=237)

Table A2. Consumption of beverages, milk, bread and vegetables among Danish men

Men	Age group[1]	Consumer proportion (%)	Daily use g/day	Std g	g/10 MJ	Std g
Beverages, with sugar	1	90	400	452	353	357
	2	67	153	221	139	187
	3	42	82	171	84	172
Beverages, artificially sweetened	1	44	142	340	130	289
	2	30	65	232	66	249
	3	26	55	206	65	274
Low-fat milk	1	47	82	132	78	127
	2	41	79	159	75	147
	3	37	58	115	61	122
Low-fat sour milk	1	44	15	29	14	28
	2	39	14	34	13	31
	3	36	11	25	11	27
High-fibre or whole-grain bread	1	96	80	59	73	49
	2	99	96	58	90	50
	3	98	104	61	108	61
Vegetables	1	100	159	79	147	79
	2	100	159	90	152	86
	3	100	135	87	141	84

[1]Age groups: 1=25–30 (n=287), 2=40–50 (n=692), 3=60–75 (n=671)

Table A3. Consumption of beverages, milk, bread and vegetables among Danish women

Men	Age group[1]	Consumer proportion (%)	Daily use	Std		Std
			g/day	g	g/10 MJ	g
Beverages, with sugar	1	82	231	272	265	298
	2	56	96	182	88	262
	3	49	76	193	99	242
Beverages, artificially sweetened	1	51	146	283	188	347
	2	35	114	332	96	182
	3	31	59	169	82	273
Low-fat milk	1	58	98	133	118	158
	2	51	78	124	101	164
	3	50	79	131	105	169
Low-fat sour milk	1	50	16	29	19	33
	2	48	14	29	18	37
	3	48	16	29	21	38
High-fibre or whole-grain bread	1	96	67	46	79	51
	2	99	78	48	98	56
	3	99	82	43	109	54
Vegetables	1	100	168	100	207	149
	2	100	176	103	224	129
	3	100	154	96	205	122

[1]Age groups: 1=25–30 (n=381), 2=40–50 (n=816), 3=60–75 (n=606)

Table A4. Consumption of beverages, bread and vegetables among Finnish girls and boys on grade 7 and 8

Secondary school	Gender	Consumer proportion (%)	Daily use	Std		Std
			g/day	g	g/MJ	g
Beverages, with sugar	1	56	149	226	21	31
	2	68	277	312	33	36
Beverages, artificially sweetened	1	16	42	125	7.9	26
	2	21	76	213	10	29
Low-fat milk	1	64	229	266	36	41
	2	69	336	365	42	46
Low-fat sour milk	1	2	3.5	25	0.6	4.6
	2	1	0.6	7.3	0.1	1.5
High-fibre or whole-grain bread	1	84	56	56	8.6	8.4
	2	80	58	54	7.0	6.2
Vegetables	1	100	140	107	22	16
	2	99	116	99	14	8.7

[1]Gender: 1=girls (n=170), 2=boys (n=136)

Table A5. Consumption of beverages, milk, bread and vegetables among Finnish men

Men	Age group[1]	Consumer proportion (%)	Daily use	Std		Std
			g/day	g	g/MJ	g
Beverages, with sugar	1	57	210	303	21	28
	2	40	159	288	17	30
	3	30	107	229	13	25
Beverages, artificially sweetened	1	17	105	316	12	39
	2	12	58	209	6.7	24
	3	4	13	81	1.7	11
Low-fat milk and low-fat sour milk	1	43	202	329	21	33
	2	34	137	262	15	29
	3	31	119	243	15	31
Low-fat sour milk	1	2	5.5	35	0.6	3.7
	2	9	30	107	3.4	13
	3	20	55	139	7.0	17
High-fibre or whole-grain bread	1	72	85	93	8.4	8.3
	2	89	113	90	12	10
	3	89	104	91	13	11
Vegetables	1	100	137	100	15	11
	2	97	134	95	15	13
	3	97	133	122	18	17

[1]Age groups: 1=25–30 (n=82), 2=40–50 (n=219), 3=60–75 (n=323)

Table A6. Consumption of beverages, milk, bread and vegetables among Finnish women

Women	Age group[1]	Consumer proportion (%)	Daily use	Std		Std
			g/day	g	g/MJ	g
Beverages, with sugar	1	30	80	159	12	24
	2	33	83	153	11	20
	3	25	64	158	10	22
Beverages, artificially sweetened	1	19	110	355	19	76
	2	9	30	135	5.3	24
	3	5	83	53	1.9	10
Low-fat milk	1	54	148	206	20	26
	2	43	111	186	17	28
	3	45	134.4	216	22	33
Low-fat sour milk	1	4	6.6	36	1.1	6.2
	2	16	35	112	4.9	15.0
	3	22	45	99	7.3	16.3
High-fibre or whole-grain bread	1	81	63	59	8.9	8.2
	2	86	74	57	11	8.2
	3	91	70	54	12	8.8
Vegetables	1	97	162	125	25	23
	2	100	170	112	26	18
	3	100	150	104	26	19

[1]Age groups: 1=25–30 (n=82), 2=40–50 (n=219), 3=60–75 (n=323)

Table A7. Energy and nutrient intake among 4–6-year-old Danish boys and girls

		Boys				Girls			
Nutrient		**Mean**	**Median**	**10th percentile**	**90th percentile**	**Mean**	**Median**	**10th percentile**	**90th percentile**
Energy	MJ	7.9	7.7	5.9	10.2	7.1	7.0	5.4	8.8
Carbohydrate	E%	51.8	52.0	46.1	57.4	51.8	51.7	46.4	57.2
Protein	E%	14.1	14.0	11.6	16.5	13.7	13.7	11.5	16.2
Fat	E%	34.1	34.0	29.1	39.4	34.5	34.4	29.2	40.1
PUFA-3	E%								
Fibre	g/10MJ	30.1	29.0	18.6	42.6	33.2	31.6	21.1	48.2
Vitamin A	ug/10MJ	904.4	822.7	449.5	1,511.7	884.1	786.0	411.6	1,534.9
Vitamin D	ug/10MJ	3.0	2.4	1.7	4.9	2.9	2.4	1.6	4.7
Vitamin E, alfatocoferol	mg/10MJ	7.8	7.7	5.8	10.0	8.2	7.9	5.9	10.5
Vitamin C	mg/10MJ	112.4	106.4	56.1	176.1	116.1	107.5	63.5	188.3
Folate	ug/10MJ	331.2	323.6	252.7	434.0	327.2	323.7	235.0	411.4
Calcium	mg/10MJ	1,324.6	1,306.4	950.1	1,706.4	1,286.5	1,236.9	899.9	1,697.5
Iron	mg/10MJ	10.0	10.0	8.1	11.8	9.7	9.6	8.1	11.6

[1]Energy= (fat*37kcal) + (protein*17kcal) + (carbohydrates*17kcal) + (alcohol*29kcal) + (sugar alcohols*10kcal) + (organic acids*13kcal).
[2]Carbohydrate= sugars + starch
[3]Enzymatic-gravimetric method (AOAC) used in assays
[4]1µg retinol equivalents= 1µg retinol + 1/12µg beta-carotene + 1/24*(alpha-carotene + gamma-carotene + cryptoxhantin)
[5]1mg vitamin E= 1mg alpha-tocopherol

Table A8. Energy and nutrient intake among 13–15-year-old Danish boys and girls

		Boys				Girls			
Nutrient		**Mean**	**Median**	**10th percentile**	**90th percentile**	**Mean**	**Median**	**10th percentile**	**90th percentile**
Energy	MJ	10.0	9.9	6.2	13.4	7.9	7.9	5.0	10.7
Carbohydrate	E%	52.6	53.0	45.2	59.8	54.2	54.2	48.2	60.7
Protein	E%	14.7	14.4	11.8	18.2	14.1	13.9	11.4	16.7
Fat	E%	32.7	32.5	25.8	39.0	31.7	31.8	25.6	37.3
PUFA-3	E%								
Fibre	g/10MJ	22.0	18.5	11.3	33.1	29.0	24.2	16.2	45.0
Vitamin A	ug/10MJ	679.8	543.3	329.9	1196.4	562.3	460.5	295.4	950.0
Vitamin D	ug/10MJ	2.7	2.2	1.5	3.9	2.6	2.2	1.3	4.7
Vitamin E, alfatocoferol	mg/10MJ	6.9	6.6	5.0	9.0	7.2	7.0	5.1	9.2
Vitamin C	mg/10MJ	102.8	91.9	47.4	183.3	127.1	113.3	55.9	206.4
Folate	ug/10MJ	308.4	298.0	211.3	414.7	317.2	312.0	218.6	423.6
Calcium	mg/10MJ	1,229.2	1159.5	826.5	1702.8	1,256.3	1,198.0	841.4	1,702.7
Iron	mg/10MJ	10.2	10.1	8.1	12.0	10.0	9.9	8.3	11.9

[1]Energy= (fat*37kcal) + (protein*17kcal) + (carbohydrates*17kcal) + (alcohol*29kcal) + (sugar alcohols*10kcal) + (organic acids*13kcal).
[2]Carbohydrate= sugars + starch
[3]Enzymatic-gravimetric method (AOAC) used in assays
[4]1µg retinol equivalents= 1µg retinol + 1/12µg beta-carotene + 1/24*(alpha-carotene + gamma-carotene + cryptoxhantin)
[5]1mg vitamin E= 1mg alpha-tocopherol

Table A9. Energy and nutrient intake among 25–30-year-old Danish men and women

		Men				Women			
Nutrient		**Mean**	**Median**	**10th percentile**	**90th percentile**	**Mean**	**Median**	**10th percentile**	**90th percentile**
Energy	MJ	11,1	10.9	7.6	14.7	8.5	8.5	5.8	11.5
Carbohydrate	E%	50.3	50.2	43.6	57.0	52.0	51.7	45.7	58.6
Protein	E%	14.7	14.5	12.1	17.6	14.6	14.7	11.9	17.4
Fat	E%	35.0	35.0	29.0	41.3	33.3	33.5	26.8	39.5
PUFA-3	E%								
Fibre	g/10MJ	18.7	16.8	10.0	28.9	29.0	25.1	15.6	43.7
Vitamin A	ug/10MJ	753.6	650.5	345.4	1282.1	645.6	548.6	335.0	1,052.2
Vitamin D	ug/10MJ	3.0	2.3	1.5	4.7	3.3	2.3	1.5	6.8
Vitamin E, alfatocoferol	mg/10MJ	7.0	6.7	5.0	8.9	8.2	7.7	6.0	10.6
Vitamin C	mg/10MJ	98.9	85.6	48.0	155.4	129.6	112.9	59.4	216.3
Folate	ug/10MJ	296.5	287.3	208.0	383.1	356.9	333.6	237.7	486.5
Calcium	mg/10MJ	1,098.4	1,069.8	735.0	1,540.0	1293.4	1,244.4	854.3	1,802.9
Iron	mg/10MJ	10.1	10.0	8.0	12.2	10.6	10.6	8.5	12.5

[1]Energy= (fat*37kcal) + (protein*17kcal) + (carbohydrates*17kcal) + (alcohol*29kcal) + (sugar alcohols*10kcal) + (organic acids*13kcal).
[2]Carbohydrate= sugars + starch
[3]Enzymatic-gravimetric method (AOAC) used in assays
[4]1µg retinol equivalents= 1µg retinol + 1/12µg beta-carotene + 1/24*(alpha-carotene + gamma-carotene + cryptoxhantin)
[5]1mg vitamin E= 1mg alpha-tocopherol

Table A10. Energy and nutrient intake among 40–50-year-old Danish men and women

		Men				Women			
Nutrient		**Mean**	**Median**	**10th percentile**	**90th percentile**	**Mean**	**Median**	**10th percentile**	**90th percentile**
Energy	MJ	10.8	10.6	7.1	14.5	8.0	7.9	5.6	10.6
Carbohydrate	E%	48.3	48.0	41.0	55.6	50.5	50.7	43.1	56.9
Protein	E%	15.5	15.4	12.8	18.4	15.4	15.3	12.4	18.3
Fat	E%	36.3	36.4	28.8	43.4	34.2	34.0	27.5	40.9
PUFA-3	E%								
Fibre	g/10MJ	21.6	19.2	11.6	34.3	33.8	30.5	18.3	53.3
Vitamin A	ug/10MJ	847.6	720.7	361.2	1,407.6	697.4	566.2	324.3	1,091.0
Vitamin D	ug/10MJ	3.6	2.6	1.7	6.5	3.7	2.6	1.6	7.9
Vitamin E, alfatocoferol	mg/10MJ	7.3	7.0	5.2	9.7	8.5	7.9	5.9	11.4
Vitamin C	mg/10MJ	99.5	88.0	48.5	163.0	135.9	119.3	61.4	228.3
Folate	ug/10MJ	313.4	297.1	220.9	418.0	386.3	364.1	253.8	522.7
Calsium	mg/10MJ	1,033.6	972.6	644.3	1485.4	1,246.9	1,196.3	808.8	1,771.4
Iron	mg/10MJ	10.9	10.7	8.6	13.6	11.3	11.2	9.0	13.7

[1]Energy= (fat*37kcal) + (protein*17kcal) + (carbohydrates*17kcal) + (alcohol*29kcal) + (sugar alcohols*10kcal) + (organic acids*13kcal).
[2]Carbohydrate= sugars + starch
[3]Enzymatic-gravimetric method (AOAC) used in assays
[4]1µg retinol equivalents= 1µg retinol + 1/12µg beta-carotene + 1/24*(alpha-carotene + gamma-carotene + cryptoxhantin)
[5]1mg vitamin E= 1mg alpha-tocopherol

Table A11. Energy and nutrient intake among 60–75-year-old Danish men and women

		Men				Women			
Nutrient		**Mean**	**Medi-an**	**10th per-centile**	**90th per-centile**	**Mean**	**Median**	**10th per-centile**	**90th per-centile**
Energy	MJ	9.7	9.4	6.4	13.1	7.6	7.4	5.4	10.0
Carbohydrate	E%	48.6	48.3	41.5	55.9	51.0	51.1	43.2	58.4
Protein	E%	15.3	15.1	12.1	18.4	15.2	15.0	12.3	18.0
Fat	E%	36.2	36.4	28.7	43.6	33.8	33.9	26.3	41.1
PUFA-3	E%								
Fibre	g/10MJ	26.1	23.3	14.4	40.3	37.9	33.7	21.5	59.6
Vitamin A	ug/10MJ	1,000.2	797.0	394.6	1,618.8	906.7	635.9	365.3	1,565.2
Vitamin D	ug/10MJ	4.2	3.1	1.9	7.8	4.2	3.3	1.9	8.4
Vitamin E, alfatocoferol	mg/10MJ	7.4	7.0	5.2	9.9	8.6	8.1	6.0	11.5
Vitamin C	mg/10MJ	103.7	92.4	52.2	169.1	148.2	135.3	69.7	244.9
Folate	ug/10MJ	322.1	306.2	225.9	436.5	394.4	372.3	260.3	559.6
Calcium	mg/10MJ	954.5	913.7	580.0	1362.8	1,188.5	1,143.6	738.4	1,712.9
Iron	mg/10MJ	11.5	11.3	9.0	14.2	11.7	11.4	9.3	14.5

[1]Energy= (fat*37kcal) + (protein*17kcal) + (carbohydrates*17kcal) + (alcohol*29kcal) + (sugar alcohols*10kcal) + (organic acids*13kcal).
[2]Carbohydrate= sugars + starch
[3]Enzymatic-gravimetric method (AOAC) used in assays
[4]1µg retinol equivalents= 1µg retinol + 1/12µg beta-carotene + 1/24*(alpha-carotene + gamma-carotene + cryptoxhantin)
[5]1mg vitamin E= 1mg alpha-tocopherol

Table A12. Energy and nutrient intake among Finnish boys and girls on grade 7 and 8

Secondary school		**Boys**				**Girls**			
Nutrient		**Mean**	**Median**	**10th per-centile**	**90th per-centile**	**Mean**	**Median**	**10th per-centile**	**90th per-centile**
Energy	MJ	8.3	8.2	5.5	11.5	6.7	6.5	4.5	9.4
Energy	kcal	1,978	1,954	1,312	2,750	1,602	1,560	1,085	2,242
Carbohydrate	E%	53	54	45	62	54	54	56	62
Protein	E%	17	17	13	21	16	16	12	20
Fat	E%	30	30	22	37	30	30	21	38
PUFA-3	E%	1.2	1.2	0,7	1.7	1.2	1.2	0.7	2.0
Fibre	g/10MJ	20	21	11	30	25	24	14	38
Vitamin A	ug/10MJ	641	589	362	920	814	653	402	1,223
Vitamin D	ug/10MJ	7.4	6.9	3.2	12	7.4	6.9	3.2	11.6
Vitamin E, alfatocoferol	mg/10MJ	10	10	7.4	13	11	11	6.6	14
Vitamin C	mg/10MJ	106	88	41	220	141	126	45	257
Folate	ug/10MJ	249	239	170	340	288	279	191	392
Calcium	mg/10MJ	1,566	1,509	922	2,364	1,556	1,544	924	2,336
Iron	mg/10MJ	13	12	9.3	17	14	13	10	18

[1]Energy= (fat*37kcal) + (protein*17kcal) + (carbohydrates*17kcal) + (alcohol*29kcal) + (sugar alcohols*10kcal) + (organic acids*13kcal).
[2]Carbohydrate= sugars + starch
[3]Enzymatic-gravimetric method (AOAC) used in assays
[4]1µg retinol equivalents= 1µg retinol + 1/12µg beta-carotene + 1/24*(alpha-carotene + gamma-carotene + cryptoxhantin)
[5]1mg vitamin E= 1mg alpha-tocopherol

Table A13. Energy and nutrient intake among 25–30-year-old Finnish men and women

Age group: 25-30		Men				Women			
Nutrient		**Mean**	**Median**	**10th percentile**	**90th percentile**	**Mean**	**Median**	**10th percentile**	**90th percentile**
Energy	MJ	9.6	9.6	6.2	13.4	7.1	6.7	4.7	10.5
Energy	kcal	2,294	2,287	1,477	3,194	1,695	1,606	1,131	2,514
Carbohydrate	E%	48	47	39	57	52	52	40	62
Protein	E%	16	16	12	21	17	16	12	21
Fat	E%	33	33	23	41	31	31	22	41
PUFA-3	E%	1.3	1.2	0.6	2.0	1.3	1.2	0.6	2.2
Fibre	g/10MJ	22	21	11	33	29	27	15	46
Vitamin A	ug/10MJ	999	660	343	1,141	901	651	454	1,632
Vitamin D	ug/10MJ	6.3	5.2	1.7	12	6.8	5.2	2.2	12
Vitamin E, alfatocoferol	mg/10MJ	11	10	6.9	15	12	11	7.4	17
Vitamin C	mg/10MJ	102	72	28	224	156	135	37	301
Folate	ug/10MJ	288	256	186	416	318	298	176	473
Calcium	mg/10MJ	1,412	1,426	714	2,051	1,490	1,408	804	2,213
Iron	mg/10MJ	13	12	9.5	18	15	14	9.8	20

[1]Energy= (fat*37kcal) + (protein*17kcal) + (carbohydrates*17kcal) + (alcohol*29kcal) + (sugar alcohols*10kcal) + (organic acids*13kcal).
[2]Carbohydrate= sugars + starch
[3]Enzymatic-gravimetric method (AOAC) used in assays
[4]1µg retinol equivalents= 1µg retinol + 1/12µg beta-carotene + 1/24*(alpha-carotene + gamma-carotene + cryptoxhantin)
[5]1mg vitamin E= 1mg alpha-tocopherol

Table A14. Energy and nutrient intake among 40–50-year-old Finnish men and women

Age group: 40-50		Men				Women			
Nutrient		**Mean**	**Median**	**10th percentile**	**90th percentile**	**Mean**	**Median**	**10th percentile**	**90th percentile**
Energy	kJ	9,401	9,008	5,591	13,493	6,877	6,491	4,629	9,502
Energy	kcal	2247	2153	1336	3,225	1,644	1,551	1,106	2,271
Carbohydrate	E%	47	47	35	58	50	51	41	61
Protein	E%	17	17	12	22	17	17	13	22
Fat	E%	33	33	23	43	31	31	22	41
PUFA-3	E%	1.4	1.3	0.6	2.2	1.3	1.2	0.7	1.9
Fibre	g/10MJ	27	26	15	43	32	29	20	47
Vitamin A	ug/10MJ	1,119	754	372	1,589	1,125	783	452	1,712
Vitamin D	ug/10MJ	8.0	7.0	2.6	16	7.0	5.8	2.6	13
Vitamin E, alfatocoferol	mg/10MJ	11	11	7.0	16	12	11	7.6	17
Vitamin C	mg/10MJ	111	80	23	237	190	161	46	361
Folate	ug/10MJ	300	286	197	391	351	323	221	490
Calcium	mg/10MJ	1,291	1,251	579	2,080	1,493	1,479	815	2,227
Iron	mg/10MJ	15	14	11	20	16	15	11	21

Table A15. Energy and nutrient intake among 60–75-year-old Finnish men and women

Age group:60-75		Men				Women			
Nutrient		**Mean**	**Median**	**10th per-centile**	**90th per-centile**	**Mean**	**Median**	**10th per-centile**	**90th per-centile**
Energy	kJ	7,913	7,575	5,156	11,196	6,053	5,860	3,881	8,241
Energy	kcal	1,891	1,810	1,232	2,676	1447	1401	928	1970
Carbohydrate	E%	49	49	37	60	51	52	40	60
Protein	E%	17	17	13	22	18	18	13	22
Fat	E%	32	31	22	43	30	30	21	40
PUFA-3	E%	1.4	1.2	0.7	2.3	1.4	1.3	0.7	2.3
Fibre	g/10MJ	32	31	17	48	36	35	21	52
Vitamin A	ug/10MJ	1,192	730	435	1,649	1,272	834	453	1,938
Vitamin D	ug/10MJ	10	8	3.2	20	11	8.5	3.6	20
Vitamin E, alfatocoferol	mg/10MJ	11	11	6.8	16	12	12	8.2	17
Vitamin C	mg/10MJ	123	92	28	266	181	151	49	346
Folate	ug/10MJ	324	298	200	454	366	341	235	514
Calcium	mg/10MJ	1,296	1,265	656	2,012	1,533	149	855	2,235
Iron	mg/10MJ	17	16	11	22	17	16	12	22

9.9 App 9. Table of applications of dietary surveys for risk assessment

Table A16. Examples on applications of national dietary surveys for risk assessment in Nordic countries

Aim of risk assessment	Institution	Food consumption data	Reference
Denmark			
To estimate intake of benzoic and sorbic acids in Denmark.	National Food Institute, Danish Veterinary and Food Administration, Denmark	7-d food diary, semi-structured questionnaire. , N=5785, children and adults aged 4−75 y	Leth T, Christensen T, Larsen IK. Food Additives & Contaminants 2010;27(6):783-792
Nitrite and nitrate content in meat products and estimated intake in Denmark from 1998 to 2006.	National Food Institute (DTU), Danish Veterinary and Food Administration, Denmark	Questionnaire, 7 consecutive days. Children and adults aged 4−75 y	Leth T, Fagt S, Nielsen S, Andersen R. Food Additives & Contaminants 2008;25(10);1237-1245
To determine the intake of intense sweeteners with non-alcoholic beverages in different age groups of the Danish population based on the monitoring results from 2005, and compare the results with the earlier investigation based on the results from 1999.	National Food Institute, Danish Veterinary and Food Administration, Denmark	Records on 7 consecutive days. The questionnaire including 20 beverages, N=3098, aged 1-80 y	Leth T, Jensen U, Fagt S, Andersen R. Food Additives & Contaminants. 2008;25(6):662-668
To assess dietary exposure of Danish consumers to dithiocarbamate residues in food and compare the deterministic and probabilistic approach.	National Food Institute, Technical University of Denmark, Denmark	7-day prospective food record with pre-coded (semi-closed) questionnaire. Adults aged 15-75 y, N= 3299, children aged 4-6 y, N= 231	Jensen BH, Andersen JH, Petersen A, Christensen T. Food Additives &Contaminants 2008; 25(6):714-721
To determine the intake of intense sweeteners with non-alcoholic beverages in different age groups of the Danish population.	Danish Institute for Food and Veterinary Research, Denmark	A 7-day pre-coded record method with closed answering categories supplemented with a possibility for open answers. N=3098, aged 1-80 y	Leth T, Fabricius N, Fagt S. Food Additives & Contaminants 2007;24(3):227-235
Finland			
To assess the MeHg intake in susceptible age groups of children from 1 to 6 years.	University of Jyväskylä, Finnish Food Authority, Evira, National Institute for Health and Welfare, University of Helsinki, Tampere University Hospital, University of Turku, University of Oulu, University of Tampere, Finland	3-day food records , consecutive days N=963, aged 1 y N=1045, aged 3 y N=850, aged 6 y	Karjalainen AK. Hallikainen A, Hirvonen T, Kiviranta H, Knip M, Kronberg-Kippilä C, Leino O, Simell O, Sinkko H, Tuomisto JT, Veijola R, Venäläinen E-R, Virtanen SM. Food and Chemical Toxicology 2012, doi:10.1016/j.fct.2012.02.074
To estimate the dietary exposure to acrylamide among Finnish children and adults.	Finnish Food Safety Authority, National Institute for Health and Welfare, University of Turku, Finland	48-h dietary recall, 3-d food record N= 2038, adults aged 25 −74 y, N= 1514, children aged 1, 3 and 6 y	Hirvonen T, Jestoi M, Tapanainen H,, Valsta L, Virtanen SM, Sinkko H, Kronberg-Kippilä C, Kontto J, Virtamo J, Simell O, Peltonen K. Food Additives & Contaminants Part A Chem Anal Contro Expo Risk Assess 2011;28(11):1483-1491
To estimate health effects of maternal fish consumption on child's central nervous system.	National Institute for Health and Welfare, University of Jyväskylä, Finnish Environment Institute, Finland	FFQ consisting 12 fish species most commonly consumed by the women. N=3827 pregnant women	Leino O, Karjalainen AK, Tuomisto JT. Food and Chemical Toxicology. 2011,doi:10.1016/j.fct.2011.06.052

Aim of risk assessment	Institution	Food consumption data	Reference
To assess the impact of energy under-reporting and the number of reporting days in dietary surveys on dioxin intake.	Finnish Food Safety Authority, National Institute for Health and Welfare, Finland	48 h dietary recall, 3-day food record, N=606, adults aged 25 −74 y	Hirvonen T, Sinkko H, Hallikainen A, Kiviranta H, Pietinen P, Valsta L, Tuomisto JT. Food Additives & Contaminants 2010;27(8):1170−1176
To describe OTC (organotin intake) exposure through fish consumption and to assess the associated potential health risks in a Finnish population.	National Institute for Health and Welfare, Finnish Food Safety Authority Evira, Finnish Game and Fisheries Research Institute, Finnish Environment Institute, Finland	48-h recall, FFQ	Airaksinen R, Rantakokko P, Turunen AW, Vartiainen T, Vuorinen PJ, Lappalainen A, Vihervuori A, Mannio J, Hallikainen A. Environmental Research 2010;110:544−547
To assess biomarker and frequency questions as measures of fish consumption.	National Institute for Health and Welfare, Finland	FFQ N= 1553, females=851, males=702	Turunen AW, Männistö S, Kiviranta H, Marniemi J, Jula A, Tiitanen P, Suominen. Taipale L, Vartiainen T, Verkasalo PK. European Journal of Clinical Nutrition 2010;64:313-323
To assess the association between dietary acrylamide intake and the risk of cancer among male smokers.	Finnish Food Safety Authority, National Institute for Health and Welfare, Finland National Cancer Institute, USA	Self-administered, modified diet history method, FFQ N=27 111, aged 50-69 y,(male smokers)	Hirvonen T, Kontto J, Jestoi M, Valsta L, Peltonen K, Pietinen P, Virtanen SM, Sinkko H, Kronberg-Kippilä C, Albanes D, Virtamo J. Cancer Causes Control 2010;21:2223−2229
Assess the mortality of fishermen and fishermen's wives in Finland, presuming the mortality reflects their high consumption of contaminated fish.	Public Health Institute, Finland	Semi-quantitative 128-item FFQ N=182 (fishermen n=88, fishermen's wives n=94)	Turunen AW, Verkasalo PK, Kiviranta H, Pukkala E, Jula A, Männistö S, Räsänen R, Marniemi J, Vartiainen T. ernational Journal of epidemiology 2008;37:1008−1017
To measure the concentration of organotin compounds in the whole blood of Finnish male fishermen, their wives and other family members and to investigate their associations with background variables.	National Public Health Institute, University of Kuopio, Finland	Semi-quantitative FFQ, Health questionnaire including detailed questions about fish consumption. N=300 (male fishermen n= 133, their wives n= 94, other family members n=73)	Rantakokko P, Turunen A, Verkasalo PK, Kiviranta H, Männistö S, Vartiainen T. Science of the Total Environment 2008;399:90−95
To estimate the intake of organotin compound from foodstuffs in a Finnish market basket.	National Public Health Institute, University of Kuopio, Finland	Balance Sheet for Food Commodities 2001 and 2002	Rantakokko P, Kuningas T, Saastamoinen K, Vartiainen T. Food Additives & Contaminants 2006;23(8):749−756
To estimate cadmium intake from moose meat and organs among hunters in Finland.	National Veterinary and Food Research Institute, University of Helsinki, Finland	Postal questionnaire containing questions related to moose meat and organ consumption N=2889	Vahteristo L, Lyytikäinen T, Venäläinen E-R, Eskola, Lindfors, Pohjanvirta R Maijala R. Food Additives & Contaminants. 2003;20(5):453-463
To determine the occurrence of PCDD/Fs and PCBs in the general adult Finnish population.	National Public Health Institute, University of Kuopio, Helsinki University Hospital, Finland	Questionnaire about intake of foods, detailed questions about subject's fish consumption habits including favored fish species. N= 420	Kiviranta H, Tuomisto JT, Tuomisto J, Tukiainen E, Vartiainen T. Chemosphere 2005;60:854−869
To estimate the dietary intake of PCDD/Fs, PCBs, and PBDEs in Finnish market baskets.	National Public Health Institute, University of Kuopio, Finland	24-h recall, N=2862 adults aged 25-64 y	Kiviranta H, Ovaskainen M-L, Vartiainen T. Environment International 2004;30:923−932

Aim of risk assessment	Institution	Food consumption data	Reference
Iceland			
To assess iodine status in Icelandic adolescent girls.	University of Iceland, Agricultural Univercity of Iceland, Landspitali University Hospital, Reykjavik, Iceland National Institute of Nutrition and Seafood Research (NIFES), Norway	FFQ with 130 items N= 112, adolescent girls aged 16-20 y	Gunnarsdottir I, Gunnarsdottir BE, Steingrimsdottir L, Maage A, Johansson AJ, Thorsdottir I. European Journal of Clinical Nutrition 2010;64:958-964
To assess consumption of caffeine from coffee, tea, soft drinks and energy drinks.	The environment and food agency of Iceland, office of food, Iceland	24 h recall. N=1242, aged 15−80 y	The environment and Food Agency of Iceland, Office of Food. UST-2004:27
Norway			
To investigate whether serum 25-hydroxyvitamin D(25(OH)D) might be compromised by concomitant intake of dl-compounds.	Norwegian Institute of Public Health, University of Bergen, Norway	FFQ N=182, adults aged 18-79 y	Birgisdottir BE, Brantsaeter AL, Kvalem HE, Knutsen HK, Haugen M, Alexander J, Hetland RB, Aksnes L, Meltzer HM. Molecular Nutrition & Food Research 2012;56:388-398
To explore associations between concentration of PFCs in serum and consumption of food with particular focus on seafood, and to compare estimated dietary intakes with determined serum PFC concentrations.	Norwegian Institute of Public Health, University of Oslo, Norway	Semi-quantitative FFQ with 340 questions, N= 175; females n=96, males n=79	Haug L, Thomsen C, Brantsaeter AL, Kvalem HE Haugen M, Becher G, Alexander J, Meltzer HM, Knutsen HK. Environment International 2010;36:772−778
To explore whether selenium, iodine, mercury or arsenic may serve as a biomarker for total fish and seafood in intake in addition to the traditionally used n-3 fatty acids EPA and DHA.	Norwegian Institute for Public Health, National Institute of Occupational Health, Rikshospitalet ,University Hospital, University of Oslo, Norway	Semiquantative FFQ, 4-d weighted food diary N=119, pregnant women	Brantsaeter AL, Haugen M, Thomassen Y, Ellingsen DG, Ydersbond TA, Hagve T-A, Alexander J, Meltzer HM. Public Health Nutrition 2009;13(1):54-62
To assess levels in food and beverages and daily intake of perfluorinated compounds in Norway.	Norwegian Institute of Public Health, University of Oslo, Norway, Örebro University, Sweden	Consumption data from the Norkost 1997 survey N=2672, adults aged 16-79 y	Haug Småstuen L, Salihovic S, Jogsten Ericson I, Thomsen C, van Bavel B, Lindström G, Becher G. Chemosphere 2010;80:1137-1143
To examine the role of dietary patterns for dioxin and PCB exposure.	Norwegian Institute of Public Health, Norway	Semi-quantitative FFQ with 340 questions. N=184, (female=101, male=83) Adults aged 21-80 y	Kvalem HE, Knutsen HK Thomsen C, Haugen M, Stigum H, Brantsaeter AL, Froshaug M, Lohmann N, Päpke O, Becher G, Alexander J, Meltzer HM. Molecular Nutrition & Food Research 2009;53:1438-1451
To investigate dietary exposure and serum levels of brominated flame retardants (BFRs).	Norwegian Institute of Public Health, Norway	Semi-quantitative FFQ with 340 questions. N=184, (female=101, male=83) Adults aged 21-80 y	Knutsen HK, Kvalem HE, Thomsen C, Froshaug M, Haugen M, Becher G, Alexander J, Meltzer HM. Molecular Nutrition & Food Research 2008;52:217-227
To examine the serum concentrations of polybrominated diphenyl ethers (PBDE) and hexabromocyclododecane (HBCD) in consumers of fish from contaminated lake and to investigate possible relationships between serum concentrations, self-reported fish intake and calculated total dietary PBDE exposure.	Norwegian Institute of Public Health, Norway	Semi-quantitative FFQ about consumption of fish caught exclusively from Lake Mjosa. females aged 9-78 y, N= 25 males aged 30-87 y, N= 41	Thomsen C, Knutsen HK, Liane VH, Froshaug M, Kvalem HE, Haugen M, Meltzer HM, Alexander J, Becher G Molecular Nutrition & Food Research 2008;52:228-237

Aim of risk assessment	Institution	Food consumption data	Reference
Sweden			
To investigate possible sources of 4-Nonylphenol and bisphenol A exposure from food.	National Food Agency, Sweden	A Swedish food market basket	Gyllenhammar I, Glynn A, Darnerud PO, Lignell S, van Delf R, Aune M. Environment International 2012;43:21-28
To perform a detailed assessment of the dietary cadmium exposure in the Swedish adult population.	National Food Agency, Uppsala University, Sweden	7-day dietary record N= 1211, adults aged 17 –80 y	Sand S, Becker W . Food and Chemical Toxicology. 2012;50:536-544
To analyze the levels of selected POPs, estimate the mean Swedish per capita intake and compare the results with the earlier Swedish market basket study from 1999.	Swedish National Food Administration, Sweden	Per capita consumption data	Törnkvist A, Glynn A, Aune M, Darnerud PO, Ankarberg EH. Chemosphere 2011;83:193-199
To estimate the average dietary exposure to toxic and essential mineral elements in the Swedish population.	National Food Administration, Department of Public Health and Caring Sciences, Sweden	Market basket study; Food balance sheets and Per capita consumption data	Becker W, Jorhem L, Sundström Bm Petersson Grawe K. Journal of Food Composition and Analysis 2011;24:279-287
To assess relation between dietary cadmium intake and biomarkers of cadmium exposure in premenopausal women.	Karolinska Institute, Sweden, Unit of Quantitative Assessment and Evidence-Building, LA-SER Europe Ltd, UK	Duplicate food portions collected during four consecutive days. N=57, females aged 20-50 y	Julin B, Vahter M, Amzal B, Wolk A, Berglund M, Åkesson A. Environmental Health 2011;10:105
To refine cadmium risk assessments in food and environment.	European Food Safety Authority , Italy, Karolinska Institutet Sweden	FFQ N=680,f 56-70 y	Amzal B, Julin B, Vahter M, Wolk A, Johansson G, Åkesson A. Environmental Health Perspectives 2009;117(8)1293-1301
To examine the intakes of nitrate and nitrite in Swedish children.	Karolinska Institutet, National Food Administration, Swedish University of Agriculture Sciences, Sweden	4-day food diary, N=2259, children aged 4-12 y	Larsson K, Darnerud P.O, Ilbäck N.-G, Merino L. Food Additives and Contaminants 2011;28(5):659-666
To examine the coherence of estimated intakes of acrylamide (AA) from foods, with hemoglobin (Hb) AA adduct levels.	Lund University, Stockholm University, Lund University Hospital, Sweden	7 day menu book, 168- item diet history questionnaire, 1-hour interview, N=142, adults aged 45-73 y	Wirfält E, Paulsson B, Törnqvist M, Axmon A, Hagmar L.European Journal of Clinical Nutrition 2008;62:314-323
To study association between acrylamide and prostate cancer risk.	Harvard School of Public Health, Boston, USA. Karolinska Institutet, Stockholm university, Sweden, Harvard Medical School, Boston USA	FFQ including 261 items, N=2617, adults aged 35-79	Wilson KM, Bälter K, Adami HO, Grönberg H, Vikström AC, Paulsson B, törnqvist M, Mucci LA. International Journal of Cancer 2008;124:2384-2390
To investigate dioxin-like pollutants via different food commodities in Swedish children and young adults.	Karolinska Institutet, National Food Administration, Sweden	7-day record, N=670, Children and young adults aged 1-24 y	Bergkvist C, Öberg M, Appelgren M, Becker W, Aune M, Ankarberg Halldin E, Berglund M, Håkansson H Food and Chemical Toxicology 2008;46:3360-3367
To estimate the dietary intakes of heterocyclic amines (HCAs) in relations to socioeconomic, lifestyle and other dietary factors.	Lund University, University Hospital Malmö, Sweden	Modified diet history method combining a 7-day menu-book and a questionnaire for assessment of meal pattern, consumption frequencies and portion sizes of regularly eaten foods. N=15 074,females=8599, males=6575	Ericson U, Wirfält E, Mattison I, Gullberg B, Skog K. Public Health Nutrition 2007;10(6):616-627

Aim of risk assessment	Institution	Food consumption data	Reference
To assess the dietary intake of persistant organic pollutants (POPs).	National Food Administration, Sweden	A market basket study based on the per capita consumption data	Darnerud PO, Atuma S, Aune M, Bjerselius R, Glynn A, Petersson Grawe K, Becker W. Food and Chemical Toxicology 2006;44:1597-1606
To explore whether dietary sources of acrylamide increase risk of colorectal cancer among women.	Harvard Medical School, USA, Karolinska Institutet, Sweden	FFQ, 67 food items N=61 467, aged 40-74 y	Mucci LA, Adami H-O, Wolk A. International J ournal of Cancer 2005;118:169-173
To assess dietary acrylamide intake and risk of renal cell cancer.	Karolinska Institutet, Sundsvall Hospital,Sweden, Harvard School of Public Health,USA	FFQ (intake of selected food items and beverages prior to 1987, 11 food items with elevated acrylamide levels, e.g. coffee fried potatoes, biscuits, crisps and other breads). Adults aged 20 -79 y	Mucci LA, Lindblad P, Steinneck G, Adami HO. International Journal of Cancer 2004;109:774-776
To study exposure to methyl mercury (MeHg) in Swedish pregnant women and their fetuses in relation to fish intake.	Karolinska Institut, National Food Administration, Swedish University of Agricultural Sciences, Sweden	FFQ including detailed questions on fish consumption, N=123, aged 20-40 y	Björnberg,KA, Vahter M, Petersson-Grawe K, Kynn A, Cnattingius S, Darnerud PO, Atuma S. Aune M, Becker W, Berglund M. Environmental Health Perspectives 2003;111(4):637-641
To investigate a possible association between dietary exposure to POC and menstrual cycle disruption.	University Hospital, Lund, Sweden	Information on fish consumption (Baltic Sea fatty fish) N=941	Axmon A, Rylander L. Strömberg U, Hagmar L. Chemosphere 2004;56:813-819

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Nordic dietary surveys

Study designs, methods, results and use in food-based risk assessments

National dietary surveys have been completed in all five Nordic countries for purposes of nutritional assessment. The NORDIRA project started in 2009 with objectives of sharing experiences within collection of food consumption data and applications of it in food-based risk assessment. The NORDIRA-group consisted of experts working within dietary surveys as well within risk assessment. The project collected results and methodological aspects of national dietary surveys, the presentations of food consumption figures and data calculation processes of risk assessment. This TemaNord report is a summary of the presentations and experiences shared during the three year period of the NORDIRA project. The group emphasizes a flexible food aggregation system in reporting food consumption to enable different kind of matching of data from food consumption and occurence of chemical substances.

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