GUIDANCE OF EFSA

General principles for the collection of national food consumption data in the view of a pan-European dietary survey[1]

European Food Safety Authority[2, 3]

European Food Safety Authority (EFSA), Parma, Italy

ABSTRACT

The availability of detailed, harmonised and high quality food consumption data at European level is a primary long term objective for EFSA which has been recognised as a top priority for collaboration with the EU Member States. This Guideline has been developed by the EFSA Expert Group on Food Consumption Data. It issues general principles to collect dietary information that can be used to estimate the nutrient intake and to assess exposure to biological agents and chemical substances considered by EFSA's Scientific Panels. It is recommended that surveys cover two non-consecutive days and use the dietary record method for infants and children and the 24-hour recall method for adults. It is further recommended to use a food propensity questionnaire and that supplementary information, in particular on brand name, physical characteristics of the packaging, cooking procedures and other specific information, such as fortification should be collected. Detailed information on the use of nutritional supplements by respondents should also be covered as well as physical measures of the survey participants (weight and height) along with an estimate of their physical activity level.

KEY WORDS

Dietary survey, food consumption, dietary records, 24-hour recalls, portion size, data collection, nutrition, risk assessment, exposure assessment.

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2 Correspondence: datex@efsa.europa.eu

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SUMMARY

The availability of detailed and high quality food consumption data is essential to carry out many of EFSA's mandates. The collection of accurate and harmonised food consumption data at European level is therefore a primary long-term objective for EFSA which has been recognised as a top priority for collaboration with the EU Member States.

Methodologies and procedures used in dietary surveys have mainly been developed with the aim of evaluating the nutritional status of a population i.e. the intake of energy, macronutrients and/or micronutrients. Specific recommendations are needed in order to make the food consumption data collected through these methods more suitable for exposure assessment within the risk assessment process.

The methods and protocols described in this Guideline are intended to be followed for harmonising results within a common pan-European dietary survey. The main objective of the present Guideline is to recommend methods and protocols for the collection of dietary information that can be used to perform risk assessments for biological agents and chemical substances considered by EFSA's Scientific Committee and Scientific Panels.

The "Expert Group on Food Consumption Data" (EGFCD) through the Guideline stresses the importance of collecting accurate and harmonised food consumption data at the European level. It recommends that each national dietary survey should be conducted in two phases. One dietary survey phase includes children, divided into three age classes: infants, toddlers and other children. The other dietary survey phase includes all other subjects, with the exception of above the age of 75 years and older), again divided into three age classes: adolescents, adults and elderly. Pregnant women should be over-sampled and included in the same phase as the adults. A minimum of 1,000 subjects has to be included in each of the two dietary survey phases. A larger number of subjects is strongly recommended for the most populated EU Member States.

The dietary survey phase covering infants and children should be conducted using the dietary record method including two non-consecutive days and should, if possible, use EPIC-SOFT as a data entry system.

The dietary survey phase covering all other subjects (except those older than 75 years) should be conducted using the 24-hour recall method including two non-consecutive days. This is considered the most cost-effective method and the main arguments in favour of this choice are that 24-hour recall is less of a burden for the subjects and thus will increase the participation rate, and since it is independent of literacy rates in different parts of the population it can be better implemented.

The EGFCD advises to collect specific information on the frequency of consumption using a food propensity questionnaire (FPQ). It is further recommended that supplementary information, in particular on brand name, physical characteristics of the packaging, cooking procedures and other specific information, such as fortification, should be collected. Detailed information on the use of nutritional supplements by respondents should also be covered as well as physical measures of the survey participants (weight and height) and an estimate of their physical activity level.

In 2007, EFSA created the EGFCD, an EFSA network with representatives from each EU Member State. The Expert Group coordinates an effort to harmonise the collection and collation of data on food consumption and endorsed the views expressed in this Guideline.

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BACKGROUND AS PROVIDED BY EFSA

Food consumption data are an essential element for the risk assessment work conducted by the EFSA. Hence, the availability of reliable and detailed data in this domain is essential to carry out its mandates.

Food consumption data from dietary surveys are available in a majority of European countries but data obtained at national level cannot be simply pooled together because of various survey methodologies, various clustering of age groups and various food categorisation systems.

The availability of harmonised and detailed food consumption data at European level has been therefore widely recognised as essential in order to improve the consistency and reliability of exposure assessments carried out by EFSA Panels and other experts in Europe.

In 2007 EFSA created the "Expert group on food consumption data". Each member of this group represents a European country that is in charge of coordinating the collection, formatting and transfer of the most recent and relevant national food consumption data to EFSA. In October 2007, the "Expert group on food consumption data" decided to create the Food Consumption and Exposure Working Group aimed at recommending methods for food consumption surveys with the view of better harmonisation across Europe.

TERMS OF REFERENCE AS PROVIDED BY EFSA

To explore the situation and develop guidelines on methods and protocols for future national dietary surveys in Europe. Specific tasks include to:

- outline requirements on food consumption studies with respect to exposure assessment,
- recommend methods for food consumption surveys with the view of better harmonisation across Europe,
- recommend procedures for the use of existing consumption data collected at a detailed food level with respect to exposure assessment,
- investigate possible collaboration with other current European initiatives in the field (e.g. EFCOVAL project, EUROSTAT, IARC, etc.),
- determine the feasibility of creating a pan-European food consumption survey.

ASSESSMENT

1. Introduction

1.1. Legal framework

The European Food Safety Authority (EFSA) has a role in promoting and co-ordinating the development of harmonised risk assessment methodologies. Pre-amble 49 of Regulation (EC) No 178/2002 of the European Parliament and of the Council states the following: "The lack of an effective system of collection and analysis at Community level of data on the food supply chain is recognised as a major shortcoming issue. A system for the collection and analysis of relevant data in the fields covered by the European Food Safety Authority (EFSA) should therefore be set up, in the form of a network coordinated by the EFSA. A review of Community data collection networks already existing in the fields covered by the Authority is called for".

In particular, access to food consumption data is integral to the risk assessment work conducted by EFSA. Hence, the availability of detailed and high quality consumption data is essential to carry out the EFSA mandates. Article 33 of the Regulation (EC) N° 178/2002 of the European Parliament and of the Council states that EFSA

> "*shall search for, collect, collate, analyse and summarise relevant scientific and technical data in the fields within its mission. This shall involve in particular the collection of data relating to food consumption and the exposure of individuals to risks related to the consumption of food*";

and that EFSA

> "*shall work in close cooperation with all organisations operating in the field of data collection, including those from applicant countries, third countries or international bodies*".

1.2. Food consumption data sources

Food consumption data reflects what either individuals or groups consume in terms of solid foods, beverages, including drinking water, and supplements. Food consumption can be estimated through food consumption surveys at an individual (Individual dietary surveys) or household level (Household budget surveys) or approximated through food supply data derived from food balance sheets. The latter two provide gross annual estimates of the type and amount of food available for human consumption within a household or country, respectively, and can be used to derive a gross estimate of average per capita food consumption with no indication of the distribution of consumption in the population. Such data at international level can be obtained through EUROSTAT[4], FAOSTAT[5] and OECD.stat[6]. In particular, the Global Environment Monitoring System - Food Contamination Monitoring and Assessment Program (GEMS/Food), implemented by the World Health Organization (WHO), used FAO Food Balance Sheet data to develop regional dietary patterns of raw and semi-processed food commodities specifically aimed at assessing the potential exposure of populations to chemicals in food.

Household Budget Surveys (HBS) are national surveys mainly focusing on consumption expenditure. They are conducted in all EU Member States and their primary aim (especially at national level) is to calculate weights for the Consumer Price Index. In contrast to food balance sheets, household surveys

[4] http://epp.eurostat.ec.europa.eu/portal/page?_pageid=1090,30070682,1090_33076576&_dad=portal&_schema=PORTAL
[5] http://faostat.fao.org/default.aspx
[6] http://stats.oecd.org/wbos/Index.aspx?usercontext=sourceoecd

can supply information on the distribution of food consumption at household level but not for the individuals belonging to the household. Foods consumed out of home are not considered in HBS. To improve the possibilities for international comparison of household survey data in Europe, the European Commission is supporting since 1993 a project of the European Union called DAFNE (Data Food Networking). EUROSTAT regularly issues recommendations for further harmonisation of the survey information and also produces a technical document describing in detail and in a comparative way, all the methodological and technical aspects of the national surveys as well as a consolidated EU quality report.

Individual dietary surveys are the only surveys that provide information on the distribution of food consumption in well-defined groups of individuals and are therefore preferred for the assessment of dietary exposure within the risk assessment process. Data from individual dietary surveys are also understood to more closely reflect actual consumption (Kroes *et al.*, 2002). There are currently no Community requirements with regard to the national collection of food consumption data at individual level. Nevertheless, national dietary surveys are already carried out in many European countries and provide valuable information for use in national policy and are central in nutritional surveillance. However, data obtained at national level cannot be directly compared due to the variety of methodologies applied across the Community. Survey methodologies range from recalling the intake from the previous day (24-hour recall), to keeping a record of the consumption of food and drinks over one or more days (dietary record). Differences exist with respect to a number of other parameters affecting the level of detail and the quality of the data collected, such as the survey design, the tools used to collect and measure the data, the clustering of age groups, food description and categorisation systems and the statistical treatment and presentation (foods as purchased versus foods as consumed) of the data. Furthermore, in some European countries a national dietary survey has not been carried out in the last ten years.

1.3. EFSA activities in the field of food consumption data

To support the establishment of a common database on food consumption, EFSA organised the Scientific Colloquium "European food consumption database – current and medium to long-term strategies" (28-29 April 2005, Brussels, Belgium). The objective of this colloquium was to have an open scientific debate on the state of the art of harmonised approaches to food consumption data collection and the development of a database on food consumption at European and international level. A report is available on the EFSA website outlining suggested future initiatives (EFSA, 2008). The discussions of the participants led to the agreement that harmonisation of food consumption data was the ultimate requirement in addressing dietary exposure assessment at the European level. The Colloquium was in favour of a Pan-European dietary survey and recommended that EFSA take a lead role in the co-ordination and completion of associated tasks in meeting this initiative. It was recommended however, that consideration would be given to how food consumption data could support other aims of a Member State, such as the collection of data for nutritional and public health purposes. The Colloquium also acknowledged the importance of co-operation and communication in the success of this initiative at national, EU and international levels.

In 2007, following the recommendations received at the Colloquium, EFSA created the "Expert Group on Food Consumption Data" (EGFCD), an EFSA network, with representatives from each EU Member State. The Expert Group coordinates an effort to harmonise the collection and collation of food consumption data and provides a platform for exchange of views between experts from the European countries. As a first initiative, the Expert group co-operated in the establishment of the "Concise European food consumption database" (Concise Database) as suggested in an opinion of the Scientific Committee on exposure assessment (EFSA, 2005). The Concise Database has been fully operational since the end of February 2008 and is the first database in Europe containing information from individual dietary surveys from the majority of EU Member States. However, the Concise Database only intends to provide consumption data on a limited number of broad food categories, to be used for preliminary exposure assessments as required.

More detailed information on food consumption in Europe is required to undertake full exposure assessments, which are an integral part of the risk assessment process carried out at EFSA. At the end of 2008 EFSA started a project aimed to establish a Comprehensive European food consumption database. Within this project, competent organisations in EU Member States were requested to provide EFSA with data from the most recent national dietary survey in their country, including the adult population data, at the level of consumption by individual consumer. The consumption data were expressed at the most disaggregated level recorded at national level. Twenty Member States accepted to participate in this project and signed a collaboration agreement with EFSA for the provision and processing of such food consumption data.

Both the Concise and the Comprehensive European food consumption database include dietary information for adult population only. In 2008, EFSA launched a call for proposals focused on children: "Individual food consumption data and exposure assessment studies for children" (acronym EXPOCHI). Within this project, food consumption data from 13 different Member States will be used to carry out exposure assessment studies for food colours, selenium, chromium and lead in children (in particular young children, 1-3 years old). Food consumption data used for the exposure assessments will be provided to EFSA at the finest level of detail by the end of 2009.

The food consumption data gathered at EFSA in the Comprehensive European food consumption database and through the EXPOCHI project are currently the best available in the EU and will be extremely useful in the risk assessment work conducted by EFSA. However, they still include important methodological differences making these data unsuitable for country-to-country comparisons. The collection of accurate and harmonised food consumption data at European level is therefore a primary long-term objective for EFSA and has been recognised as a top priority for collaboration with the EU Member States. In line with the data collection remit specified in EFSA's founding regulation, the present guideline is aimed at identifying the most convenient method and protocol to be used for individual dietary surveys within a pan-European context, in order to obtain a harmonised food consumption database at European level that could be used by EFSA within the risk assessment process.

1.4. Dietary information needed at EFSA

EFSA's remit covers food and feed safety, nutrition, animal health and welfare, plant protection and plant health. EFSA's most critical commitment is to provide objective and independent science-based advice and clear communication grounded in the most up-to-date scientific information and knowledge. In particular, EFSA Scientific Panels perform risk assessment for a variety of agents and chemical substances, such as:

- Biological components (e.g. micro-organisms), by the Biological hazards (BIOHAZ) Panel,
- Nutrients and novel foods, by the Dietetic products, nutrition and allergies (NDA) Panel,
- Food additives and nutrient sources added to food, by the Food additives and nutrient sources added to food (ANS) Panel,
- Food contact materials, enzymes, flavourings and processing aids, by the Food contact materials, enzymes, flavourings and processing aids (CEF) Panel,
- Pesticides, by the Plant protection products and their residues (PPR) Panel and the Pesticide Risk Assessment Peer Review (PRAPeR) Unit,
- Additives used in animal feeding, residues from animal drugs, by the Additives and products or substances used in animal feed (FEEDAP) Panel,
- Substances produced from genetically modified micro-organisms, by the Genetically Modified Organisms) GMO Panel, and
- Natural toxins, environmental and industrial contaminants (e.g. heavy metals, mycotoxins, dioxins) and process contaminants (acrylamide, furan, etc.) by the Contaminants in the food chain (CONTAM) Panel.

In all these fields, the availability of accurate and detailed food consumption information is fundamental to assess the exposure to hazardous substances within the risk assessment process or to estimate the intake of substances with potential beneficial effects. In lieu of compatible detailed data, assumptions are made in order to carry out risk assessments that generally conclude in an over-estimation of the actual risk, but the possibility of under-estimation cannot be excluded.

This information can also be extremely useful in other areas related to food safety, such as for the evaluation of new European food legislations, the communication on risks associated with the food chain and the estimation of the effects of a particular trend in diseases caused by infectious agents that can be transmitted between animals and humans.

When using food consumption data for assessing exposure, significant differences in the format and content of the database may be required based on the target substance for which the exposure has to be assessed. In particular, the level of detail concerning the description of food items is important for most of the assessments. Assessment of exposure in specific population groups can be of particular interest for the evaluation of certain agents and chemical substances.

1.4.1. Food description

In general, it is important that foods consumed are described in detail and that industrially produced composite foods or home-made dishes, such as a ready-made frozen pizza or a home cooked beef stew, are disaggregated as much as possible into their main ingredients at a level that can be reported by the subjects. In the case of a sandwich with ham and butter it is important to distinguish between the three components such as bread, ham and butter. It is also important to register detailed information concerning each single component like, the type of ingredients used in the bread, e.g. grain used or at least whether or not it was wholemeal bread; whether the butter was salted or fat reduced, and whether the ham was raw, cooked and/or smoked.

There is no clear distinction between an ingredient, a food, a home cooked dish made following a recipe and a composite food. Someone can make bread at home, using water, flour and other ingredients, and therefore consider it as a recipe. The bread can be considered as a food when it is consumed alone and itself as an ingredient when consumed within a sandwich, as in the example above. A sandwich can be a homemade dish or a composite food, depending on whether it is prepared at home or purchased ready to eat. Despite the complexity, it is important to disaggregate the reported product into ingredients whenever possible. However, bread and other foods that are mainly purchased as such, but can also be produced at home, such as yogurts, jams, pasta, etc., do not have to be disaggregated into the basic ingredients; it is enough to specify that they were produced at home.

Different types of information may be needed based on the different agents and chemical substances under evaluation. In the case of substances added at industrial level (food additives, flavourings, enzymes, etc) it could be of great help to have foods described at the level of the brand or described even further. In the case of a yogurt, for example, it may be necessary to know the flavour to identify the presence of flavourings. If the brand name of a food is recorded, additional information like fortification can be obtained from the food labels. The brand is particularly important in the case of infant formulae due to little variability in the consumption patterns of infants. Additionally, information about the physical characteristics of the packaging (e.g. glass, paper, plastic or aluminium) can be critical in order to estimate exposure to food contact materials. The possibility to identify foods packaged in the shops, bought loose (e.g. fruit), or packaged under modified atmosphere can also be useful in the evaluation of biological components. Furthermore, when micro-organisms are considered, the information needed may include whether the food was prepared at home or purchased ready-to-eat, how it was heated and the place where it was consumed (e.g. at home, in a restaurant, etc.).

In the case of contaminants formed during processing (e.g. acrylamide and furan), reliable exposure assessments can only be obtained by using food consumption data that includes information on

cooking procedures. In the case of acrylamide and furan it would be ideal to know, not only that a certain food was fried, but also have an indication of the temperature used.

In pesticide monitoring programs, occurrence levels are analysed in Raw Agricultural Commodities (RACs), which include any food in its raw or natural state, including all fruits that are washed, or otherwise treated in their unpeeled natural form before being put on the market. RACs are also predominantly used in the analysis of mycotoxins and heavy metals. Subjects cannot report this level of details within a dietary survey, but they must provide sufficient information so that it can be transformed into the consumption of RACs by means of assumptions. For example, if a subject reports the consumption of bread, it is not necessary to break down the bread into its basic ingredients, but it is sufficient to have the type specified, e.g. wholemeal bread, in order to allow the estimation of the consumption of grain by use of standard recipes.

Specific information that can be collected include whether products are smoked, sugar free or fortified in order to accurately assess the exposure to smoke flavourings, intense sweeteners and vitamins and minerals, respectively. More specific information might include animal origin for products such as milk and cheese, and whether the product was pasteurised or not. It could also be useful to collect information on consumer-grown vs. purchased products.

The detailed description of the consumed foods and the break down of composite foods into ingredients allow the association between food consumption data and food composition tables and therefore the estimation of nutrient and vitamin intake from the diet. However, in order to accurately estimate the intake of nutrients and vitamins, information on consumption of fortified foods as well as on the consumption of nutritional supplements at brand level must also be collected.

1.4.2. Short and long term consumption

Different types of information may be needed in different consumption scenarios. In particular, it may be important to capture habitual consumption to be able to make a distinction between acute (short-term) and chronic (long-term) exposure based on the duration required to elicit toxic or beneficial effects. Acute exposure could arise from a single-eating occasion during a 24-hour period, while chronic exposure typically refers to long-term exposure covering an average daily exposure over the whole lifetime. The collection of food consumption data at the level of a single eating occasion allows accurate estimation of acute exposure. On the other hand, it is more difficult to estimate long-term exposure since dietary surveys only cover the individuals' food consumption over a limited timeframe, due to logistic and other practical limitations. In any case, the larger the number of replicates (survey days) in a dietary survey, the higher is the likelihood of accurately estimating the within-person variability. In the case of rarely consumed foods, when a sufficient number of dietary measurements are available, statistical modelling will allow a more accurate identification of real non-consumers of a particular food. However, food consumption surveys should also be designed to be able to cover rarely consumed foods that might not be captured even when using an extended survey period. In this perspective, short-term measurements should be supplemented by additional information about the frequency of consumption of specific food items selected on the basis of their potential contribution to the exposure of specific hazardous (or beneficial) substances or agents (See section 3 of this document). In a probabilistic framework, this would allow the estimate of within-person variability of intake also in the case of rarely consumed foods.

1.4.3. Target populations

Food and beverage consumption patterns vary significantly within Europe. The European Prospective Investigation into Cancer and Nutrition (EPIC) study, for example, showed high variations in the consumption of fruits and vegetables, legumes, butter and vegetable oils between EU countries (Slimani *et al.*, 2002). In order to assure public health across Europe, it is necessary to collect representative food consumption data that identify each EU country or, at least, different geographical regions covering EU Member States with similar consumption patterns.

With respect to the different population groups for which consumption data are needed, infants and young children are considered the most vulnerable; therefore this group takes priority for exposure assessments to the majority of biological agents and chemical substances considered by EFSA. This is due to the fact that infants and young children have higher food consumption per kilogram body weight and as a result higher estimated exposure levels. In most cases, exposure assessed in this population group is higher than that estimated for all other age groups, for that reason it guides the risk assessment process. The lack of harmonised consumption data at a European level for infants and young children is an important drawback for the risk assessments conducted by EFSA. The importance of acquiring consumption information for these population groups at a European level is further emphasized by the fact that nationally representative food consumption data are lacking for a large majority of EU Member States.

Pregnant women are also considered an important population group within most areas related to food safety studies. Data on the consumption patterns of the elderly, especially of those older than 75 years, are of particular interest when biological agents are considered, whereas they are not a priority when chemical substances are under consideration. Their vulnerability relates to a diminished efficiency of the immune system with increasing age that makes them more at risk of infection and more severely affected by communicable diseases.

In order to identify consumption patterns possibly associated with a higher risk of exposure, subjects with special dietary habits due to their personal choice (e.g. vegetarians) or special dietary requirements due to health problems (e.g. diabetics and celiacs) should be identified. Information should also be collected in order to assess exposure in subjects belonging to different ethnic groups and different socio-economic strata since these two aspects might be correlated with consumption patterns.

1.5. Scope of the present Guideline

Methodologies and procedures used in dietary surveys have mainly been developed with the aim of evaluating the nutritional status of a population, i.e. the intake of energy, macronutrients and/or micronutrients. Specific recommendations can be defined in order to make the food consumption data collected through these methods more suitable for exposure assessment within the risk assessment process.

The main objective of the present Guideline is to recommend general principles for the collection of dietary information that can be used, as described above, to estimate the intake of nutrients and vitamins and perform risk assessment for all possible biological agents and chemical substances considered by EFSA's Scientific Panels. Detailed protocols putting into practice the general principles recommended in the present Guideline must be elaborated before starting the collection of the food consumption data. In particular, the EGFCD recommends that EFSA's Units and Panels should again be consulted when the specific requirements on how foods and beverages must be described will be developed.

Although individual procedures described in this Guideline can be voluntarily applied for independent national dietary surveys, they must all be followed for harmonising results within a pan-European dietary survey.

2. Sampling

2.1. Study population and exclusion criteria

The first step of a sampling procedure is the precise definition of the study population to be represented by the sample. This study population should be representative of the population considered in the risk assessment. For instance, subjects living in small and remote overseas territories can be excluded from the study population when it is impossible or very expensive to reach them.

In theory, the study population of a pan-European dietary survey includes all people living in the European Union at the time of the study. However, in order to precisely define the study population, it is necessary to agree on exclusion criteria. Institutionalised subjects, such as the elderly in retirement homes or people residing in hospitals, prisons or military barracks, are often not included in dietary surveys. Within the EFCOSUM project (TNO, 2001), the exclusion of institutionalised subjects in national dietary surveys was reported for 16 out of 23 countries. In line with what has been done by the majority of the EU Member States, the EGFCD suggests that institutionalised subjects are excluded from the study population of a pan-European dietary survey since their inclusion would make the sampling procedures too complicated.

The study population can also be defined based on the age of the subjects. The EGFCD suggests that each national dietary survey is conducted in two phases.

The first dietary survey phase including children is divided according to the following three age classes:

- Infants up to and including 11 months
- Toddlers from 12 up to and including 35 months of age
- Other children from 36 months up to and including 10 years of age.

The second dietary survey phase including all other subjects, with the exception of the very elderly (above 75 years of age), is divided according to the following three age classes:

- Adolescents from 11 up to and including 17 years of age
- Adults from 18 up to and including 64 years of age
- Elderly from 65 up to and including 74 years of age

As previously described, elderly people deserve special attention due to possible memory problems and they would require a particular methodology for the collection of food consumption information. It is often difficult to obtain an acceptable response rate for this population group within a national survey, especially if institutionalised subjects are excluded.

In 2010 the NDA Panel will define age classes within an opinion concerning principles for deriving and applying dietary reference values. The EGFCD supports the use of harmonised definitions of age ranges.

The EGFCD recommends that both proposed dietary survey phases, one for children, including the above mentioned three age classes, and the other for all other subjects, be conducted in each EU Member State. The EGFCD strongly suggests that, in case of limited resources, priority should be given to infants and children since they are the most vulnerable group.

Language barriers are sometimes used as exclusion criteria. Subjects who are illiterate or who can't read or speak the official national language are often excluded because of the costs related to the translation of the questionnaires into different languages and to the availability of interviewers who speak these languages. The EGFCD recommends that excluding subjects due to language barriers be

kept to a minimum. The immigrant populations in European cities are growing and it is important to capture their consumption patterns since ethnic foods can be important sources of exposure to certain hazardous substances.

It can be difficult to identify and capture pregnant women in dietary surveys. However, coverage of this group is critical in risk assessment since toxicological studies often refer to this population in particular. The EGFCD therefore suggests that pregnant women be included in the study population of a pan-European dietary survey in the same phase as adults. If resources are available, it is suggested that pregnant women be over-sampled; this will require the use of a sampling design different from the one used for the general population. Their recruitment could, for example, be facilitated through the use of medical doctors or hospitals.

2.2. Sampling frame

As soon as the study population is defined, a decision must be taken with respect to the "sampling units", also known as "statistical units", and the sampling frame. The sampling unit is that element or set of elements considered for selection at some stage of sampling. In a multi-stage sample, the sampling units could be geographical areas, households, or individuals. The sampling frame is the actual list of sampling units from which the sample, or some stage of the sample, is selected. The sampling frame is simply a list of all sampling units belonging to the study population. The definition of study population and sampling unit is often subject to the existence of a sampling frame. The availability of sampling frames may vary significantly from country to country. In some countries, mainly for confidentiality reasons, it is not possible to have access to existing sampling frames. The population register is the preferred sampling frame according to the EGFCD. However, a reliable and accessible register of individuals is only available in a few EU Member States. A good alternative is census data accessible in a large majority of EU countries for adults, 18 out of 23 countries according to the EFCOSUM report (TNO, 2001). Census data could be too old in order to sample children younger than 10 years old and cannot be used to sample pregnant women.

Cooperation with the national institutes of Statistics is advisable when using a register of individuals or data from the census. The optimal solution, according to the EGFCD, would be the collaboration with EUROSTAT for the use of the same sampling procedure followed by national institutes of Statistics for the selection of the sampling units used in the national household budget surveys. This would improve the comparability between the two sets of data. The use of the sampling procedure of the national household budget survey has been applied in the national dietary survey conducted by means of a 24-hour recall in Poland (Sekula *et al.*, 2005).

In case the register of individuals and the census data are not available, an optional sampling frame can be the electoral list, but then it would not be possible to get information on children and adolescents. The list of telephone numbers has also been used as a sampling frame in recent national dietary surveys (e.g. in Italy, Leclercq *et al.*, 2009), but there are more and more individuals with only a mobile phone and in some countries there is no unique register of mobile phone numbers. For this reason sampling frames used by market research panels and also electoral lists are preferred over telephone number lists. In certain countries, medical centres and practitioners can provide lists of individuals that can be used as sampling frame mainly for pregnant women and infants, but in some cases for adults as well.

In the specific case of children (infants, toddlers and other children), kindergarten and schools can be used as sampling units. However, this approach can be an important source of bias in the sample due to the differences in the education systems across EU Member States. The use of pre-schools or schools as recruitment or interview sites may also require the cooperation of Ministries of Education or related organisations.

2.3. Sampling method and design

Once the study population, sampling units and sampling frame have been defined, a decision must be taken with respect to the sampling method. The use of a random sample ensures a better characterisation of biases and non-respondents together with the possibility of calculating confidence intervals and statistical tests.

The method can simply be based on uniform random sampling of the unique probability of inclusion for all the statistical units in the sampling frame. Unfortunately it is common that a multistage sampling method is used to reduce the cost of the survey. Multistage sampling methods require the definition of different groups of statistical units, as homogeneous as possible within the group and heterogeneous among the different groups, named strata. In the specific case of a dietary survey, the definition of the strata must be mainly based on criteria related to consumption patterns. The statistical units are then randomly sampled independently in the different strata. This allows reducing sampling biases because the part of the variability of the studied indicator explained by the strata is controlled (Cochran, 1977). Stratification allows using different sampling rates according to the different strata. When there is more variability in a stratum, it can be convenient to over-sample the statistical units belonging to this group.

Within the EFCOSUM project (TNO, 2001), the use of multistage sampling in national dietary surveys was reported for 15 out of 21 countries. A multistage sampling method with four stages (counties, geographical segments, households and individuals) is used in the National Health and Nutrition Examination Survey (NHANES), which is a program of studies designed to assess the health and nutritional status of adults and children in the United States.

The EGFCD suggests the use of a random multistage sampling with the following variables to define strata: age class, gender, residence in regions (especially for large countries), residence in urban or rural areas, residence in seaside or countryside and the number of individuals belonging to the household. Sampling at individual level is preferable but in case the census is the only sampling frame available, it is suggested to sample individuals in households.

The EGFCD also recommends the definition of a harmonised statistical analysis plan in order to be able to estimate statistics representing the population studied. This plan should address the following topics: management of non-respondents, calculation of weighting factors, and complex sampling design management.

Only in case a sampling frame is not available the EGFCD suggests the use of a non-random method called the "quota sampling method" that is commonly used in consumer research. This method is well suited for a situation where, although a list of names to be drawn at random is not available, there is information on the structure of the population under study. Basically, a purposive sampling method is adopted where the sample is formed without using any randomisation techniques. The choice of units for inclusion in the sample is aimed at representing certain structural aspects of the population. In this way, the available data allow the structure of the entire population to be described in advance through the use of grids (or tables). The same quotas (i.e. percentages) must then be followed in forming the sample. The main advantage of this method is that the only information needed is statistics on the reference population (age class, gender, region of residence, etc.). The idea is that there is a bias linked to the non-random approach, but the quotas, a kind of strong stratification, reduces the sampling error. An important drawback of the "quota sampling method" is that it does not allow the estimation of the response rate.

The sampling design must also consider that, in order to capture the inter-seasonal variability in consumption patterns, sampled subjects must be uniformly distributed over the four different seasons and each seasonal sample must represent each stratum. Considerable differences have been found between food intake on weekdays and weekend days for different age and gender groups (Lyhne *et al.*,

2005). The survey calendar must therefore be organised in order to capture an adequate proportion of weekdays and weekend days at population group level.

2.4. Sample size and response rate

The sample size of a dietary survey per country is generally considered dependent on the variability of dietary consumption within each country. Information on this variability at national/regional level is therefore needed in order to determine the number of subjects to include in a survey.

There are two main steps in the determination of the sample size: the choice of the statistics of interest (i.e. mean, median, variance), and the level of precision needed. In the case of an international dietary survey, the sample size is dependent on a large number of parameters. For example, in the EFCOSUM project the sample size per country was estimated to be, on average, equal to 1,000 subjects for mean fat (lipid) intake, or to be equal to 2,000 subjects for mean fruit and vegetable intake. In both cases, a desired precision of 5% was used. Larger sample sizes are usually advocated in countries with relatively larger populations, and greater variability of consumption.

In addition, the accuracy of estimates of high consumption levels (percentiles 95th, 97.5th and further), which are key elements in risk assessment, is related to the sample size of a survey. Percentiles calculated on a limited number of subjects bear large uncertainty, and are likely to provide biased estimates. According to Kroes *et al.* (2002), high percentiles (p) can be assessed with sufficient accuracy if the sample size *n* satisfies the rule n (1-p) $\geq$ 8. The minimum sample sizes for the 95th, 97.5th and 99th percentiles can therefore be estimated to be equal to 160, 320 and 800, respectively. Similar conclusions can be derived using a binomial distribution (Conover, 1971). In particular, assuming a statistical significant level equal to 1%, the minimum sample sizes for the 95th, 97.5th and 99th can be estimated to be equal to 130, 263 and 662 respectively. The same assumptions hold true for low percentiles.

In light of these considerations, the EGFCD recommends for each country the inclusion of at least 260 subjects, 130 males and 130 females, in each of the 6 age classes identified in section 2.1 (Infants, Toddlers, Other children, Adolescents, Adults and Elderly). In order to include pregnant women, as previously suggested, another 130 subjects are to be included. This would lead to a minimum of 1,690 participants per country. Since large countries are likely to show a variety of consumption patterns in the different geographical areas, they require the inclusion of additional subjects. The inclusion of further information on study participants (such as residence in regions, residence in urban or rural areas, residence in seaside or countryside and the number of individuals belonging to the household) must also be considered during the sampling phase. A lower number of subjects could be acceptable for the infant group since their variability in consumption is lower than for other population groups.

Based on the above calculations and in line with estimates in the EFCOSUM project, the EGFCD suggests that a minimum of 2,000 subjects are sampled from each country to represent the total population at national level. This means that at least 1,000 subjects have to be included in each of the two above mentioned dietary survey phases. The inclusion in the study of a larger number of subjects is strongly recommended by the EGFCD, in particular for the most populated EU Member States.

The response rate in national dietary surveys is generally low, between 33% in Italy (Leclercq *et al.* 2009) and 70% in The Netherlands (Voedingscentrum, 1998.), which is partly reflecting a general trend towards lower response rates over time. This problem is associated with low respondent motivation, and the burden of partaking in such surveys. In addition of choosing data collection methods with a lower burden for the respondents, also other kind of measures to keep the participation rate as high as possible are needed and are used in many countries, e.g. flexibility in recruiting (times available for the interview, second call, if a no show etc.) and local awareness of the study by newspaper articles. The EGFCD suggests favouring procedures aimed at reducing, as far as possible, the participants' burden, to possibly increase the participation rate. In any case, it is deemed important to collect information on non-respondents in order to eventually correct for differences in response

rates between groups of the population. If necessary, a post-stratification method can be applied to achieve this aim (Ardilly, 1994).

3. Dietary assessment methodologies

As described in the Introduction chapter of the Guideline, the food consumption data needed by EFSA must be provided at individual level. Several dietary assessment tools directed at the individual are available. In general, these methods can be divided into two basic categories: those that record data at the time of eating (prospective methods, i.e. so-called weighed and estimated records methods) and those that collect data about the diet eaten in the recent past or over a longer period of time (retrospective methods, interview methods). Interview methods may refer to current diet (24-hour food recalls) or habitual diet (dietary history and food frequency method) (Van Staveren & Ocké, 2006). A description of the main dietary assessment methods is given below.

3.1. Diet history

The dietary history method assesses the whole daily food intake of an individual and usual meal pattern over varied periods of time. In theory, the history may cover any period in the past, but most often it covers the previous month, 6 months, or year. Originally, Burke *et al.* (1947) developed the dietary history technique in 3 parts: a detailed interview about the usual pattern of eating, a food list asking for the amount and the frequency of eating, and a 3-day diet record. Today the diet history is applied in many ways. Therefore the term dietary history is probably more appropriate in case of dietary assessment methods designed to estimate a person's usual intake and to collect certain characteristics of foods consumed at the same time (Thompson and Subar, 2008). Computerised versions of the dietary history method also exist; they can be either interviewer-administered or self-administered. The best-known diet history software in Europe is DISHES (Mensink *et al.*, 2001). These types of standardised and labour-extensive dietary history interviews (approx. 35 minutes for DISHES) can be used in large-scale population studies. DISHES was used as one of the three types of dietary assessment methods in the 2nd national German food consumption survey (Brombach *et al.*, 2006). The strengths of the method are as follows: information on the entire diet is obtained, the information is often available on foods consumed by meal and the method does not affect the eating behaviour. On the other hand, its weaknesses consist of the intake not being precisely quantifiable, it is a difficult cognitive task for the respondent and the intake is often misreported (Thompson and Subar, 2008). The dietary history method is aimed at assessing usual meal patterns and details of food intake and the data collected cannot be used for acute risk assessment. The maximum obtainable level of detail is limited and information like brand names, and packaging cannot be collected with reference periods of one month or longer. These drawbacks make the dietary history method unsuitable as a main dietary assessment method for a pan-European dietary survey for the purposes of EFSA. It can be valuable as an additional approach in combination with short-term dietary assessment methods.

3.2. Food frequency method

The food frequency method consists of a questionnaire containing a given list of foods, for which subjects are asked to estimate the habitual frequency of consumption during a specified period of time. A food frequency questionnaire (FFQ) is considered semi-quantitative if the instrument addresses both the frequency and the amount of each food item consumed (Willett *et al.*, 1998). FFQs vary in the foods listed, length of the reference period, response intervals for specifying frequency of use, procedure for estimating portion size and manner of administration. The study aims must be taken into account when developing the food list; with reference to energy and nutrients this is preferably done using a nationwide database approach (Cade *et al.*, 2002). The advantages of a food frequency method are that the questionnaire is standardised, the method can be automated easily, it is not very costly and does not influence eating behaviour. The weaknesses of this method include that memory of food use in the past is required, it is a difficult cognitive task for the respondent, the quantification of the foods consumed is not precisely quantified (Thompson and Subar, 2006), the high aggregation level of foods included and it is often based on a closed list of foods (Biro *et al.*, 2002). Food propensity questionnaires (FPQ) only include questions on consumption frequency and not on portion sizes (Subar *et al.*, 2006).

The food frequency method is used for assessments of usual meal patterns. Being similar to the dietary history methodology, the data cannot be used for acute risk assessment and the maximum level of details obtainable is limited. This makes the method unsuitable as main dietary assessment method for a pan-European dietary survey for the purposes of EFSA. However, it can be considered as an additional approach in combination with short-term dietary assessment methods (See section 3.7 of this document).

3.3. Dietary Records

In the weighed record technique the subject is taught to weigh and record all foods and beverages immediately before eating and to weigh and describe any leftovers. In most surveys not all items are weighed. Where weighing would interfere with normal eating habits, describing the quantity of foods consumed is acceptable. For example, for snacks eaten between meals or meals eaten in a restaurant, the interviewer will estimate weights from the description of the foods consumed. The weighed method differs from the estimated record where subjects do not use a scale but keep records of portion sizes of all the foods they eat on one or more days. The portion sizes are described using portion size measurement aids (see chapter 5), such as natural units (household measures) by using the utensils commonly found in homes (Van Staveren & Ocké, 2006).

The form used to record consumption may be closed or open. A closed form is a pre-coded list of all of the commonly eaten foods in units of specified portion size and grouped by nutrient composition. This list allows for rapid data entry or web based use (e.g. Sweden); it could be less adequate because not all consumed foods might be listed and it requires subjects to describe the foods eaten in defined units that may be unfamiliar. A semi-open form may be meal-based and pre-structured with many foods and amount options listed, but including sufficient space for other non-listed foods and amounts. Usually records are kept for 1-7 days. However, in practice no more than 4 consecutive days are recommended to be included, as accuracy of reported consumption is prone to error due to respondent fatigue (Gersovitz *et al.*, 1978, Swan *et al.*, 2009).

Prior to recording consumption, the survey participants have to be trained on how to adequately describe the foods, amounts consumed, cooking methods, etc. The record may be combined with a face-to-face check with the interviewer after the first day. At the end of the recording period, the record should be thoroughly reviewed with the subject. A skilled interviewer can make records more accurate by clarifying the entries and by adding any omitted items and amounts (Biro *et al.*, 2002). This check can be combined with data entry at the subject's home if this can be done in a limited time frame, usually when only one-day diet records are kept. If not, data entry should be done as soon as possible so that the subject can be contacted again if necessary.

Information on food consumption is recorded per day, usually per meal and in between meals. This allows assessment of acute exposure (Kroes *et al.*, 2002). Information on food consumption for a few days may not actually represent usual intake. However, statistical techniques can be used to estimate usual intake, provided that two or more repeated and independent days are available (Dodd *et al.*, 2006), although consecutive days cannot be considered as independent days.

The dietary record method is suitable as a main dietary assessment method for a pan-European dietary survey to serve EFSA's purposes. However, a drawback might be illiteracy levels in some minority groups across Europe.

3.4. Dietary recall

During the interview an individual recalls actual food intake for the immediate past 24 or 48 hours or for the preceding days. The 24-hour dietary recall is the most common recall method used. Food quantities are usually assessed by use of household measures, food models, or photographs. The interviewer obtains information during a personal interview or by telephone (Van Staveren & Ocké, 2006). The recall is traditionally conducted using open or structured forms, but computer-assisted interviews have become common (Slimani *et al.*, 1999, Conway *et al.*, 2003). Well-trained

interviewers are crucial in administering 24-hour recall interviews because this information is obtained by asking probing questions. However, recently self-administered automated web-based 24-hour recalls have been developed for children/adolescents (Baranowski *et al.*, 2002; Vereecken *et al.*, 2008) and adults (e.g. ASA24[7] by the National Cancer Institute in the USA). The validity of these methods needs to be assessed.

Most commonly the recalled day is defined as from when the respondent gets up one day until the respondent gets up the next day. The 24-hour recall is often structured with specific probes to help the respondent to remember all foods consumed throughout the day. Sometimes at the end of the interview there is a checklist with foods or snacks that might be easily forgotten. Computer assisted 24-hour recalls usually consist of multiple steps (Slimani *et al.*, 1999, Conway *et al.*, 2003). It is advised that no prior notification be given to the subjects about whether or when they will be interviewed about their food intake. Although notification could help the memory of some subjects, others might change their usual diet in some way for the occasion.

As in the case of the dietary record technique, information on food consumption is usually recalled per day, per meal and in between meals allowing assessment of acute exposure (Kroes *et al.*, 2002). The repetition, per each subject, of a 24-hour recall on non-consecutive days provides consumption data on independent days and, consequently, the estimation of the within-person variability of intake.

The 24-hour dietary recall method is suitable as a main dietary assessment method for a pan-European dietary survey to serve EFSA's purposes.

3.5. Comparison of diet record and diet recall

The 24-hour recall is currently the most commonly used method in Europe. Information collected within the project aimed at the development of the EFSA Comprehensive Database (Table 1) shows that the 24-hour recall and the dietary records method were used in the latest national dietary survey by 12 and 8 EU Member States, respectively.

[7] http://riskfactor.cancer.gov/tools/instruments/asa24.html

Table 1: National survey method, year of collection and number of measurements used in the latest national dietary survey by the 27 European Union Member States.

Country	Method	Year of collection	Number of replicates
Austria	24-hour recall	2005-2006	1
Belgium	24-hour recall	2004-2005	2
Bulgaria	24-hour recall	2004	1
Cyprus	Information not available		
Czech Republic	24-hour recall	2003-2004	2
Denmark	Pre-coded food diary with open fields	2000-2002	7
Estonia	24-hour recall	1997	1
Finland	2*24-hour recall	2007	1[(a)]
France	Dietary record	2006-2007	7
Germany	24-hour recall [(b)]	2005-2007	2
Greece	National dietary survey not available		
Hungary	Dietary record	2003-2004	3
Ireland	Dietary record	1997-1999	7
Italy	Dietary record	2005-2006	3
Latvia	24-hour recall	2008	2
Lithuania	24-hour recall	2007	NA
Luxemburg	National dietary survey not available		
Malta	National dietary survey not available		
The Netherlands	24-hour recall	2003	2
Poland	24-hour recall	2000	1
Portugal	National dietary survey not available		
Romania	Information not available		
Slovakia	24-hour recall	2006	1
Slovenia	24-hour recall	2007-2008	1
Spain	Dietary record	1997-2000	3
Sweden	Dietary record	1997-1998	7
United Kingdom	Dietary record	2000-2001	7

[(a)] including 2 consecutive days covered separately but during the same interview session

[(b)] Other methods were also applied in sub samples of the population.

As the dietary record and the 24-hour recall both appear suitable for EFSA's purposes, these two methods are compared in the following paragraphs on various aspects considered relevant for a pan-European dietary survey. In particular, the EGFCD decided to compare the two methods according to the following five parameters: "level of details", "intra individual variability", "response rate", "applicability to different population groups" and "cost/benefit".

The dietary record seems to provide a higher level of detail, but this is not always given by the participants. Sometimes, the "field worker" can complete missing details during completeness check (Biro *et al.*, 2002). The description of the consumed foods and beverages can be very detailed, arriving at the level of the brand name or further, if required. Specific information on food packaging materials can also be obtained, especially if respondents are asked to keep the packaging materials (Duffy *et al.*, 2006). In the case of the recall method, the level of details of food description can be limited by the memory of the respondents. The interviewer can ask about the brand name or other details, but subjects can encounter difficulties in answering. The level of details might be increased if the

respondent is at home during the interview, provided that leftover of the foods or the same foods are available.

Concerning the capacity of collecting information on less frequently or rarely consumed foods, the open form food records provide better data capture than the closed format, which for this reason is considered as inappropriate. However, the sample size and number of records are often inappropriate to capture sufficient consumers of rarely consumed foods using both the dietary record and the 24-hour technique.

The EGFCD agreed that non-consecutive days, because of their independence, allow the capture of a better estimate of the existing intra-individual variability than consecutive records. This can be particularly important in order to estimate habitual dietary intake, since statistical methods used to reduce intra-individual variance of intake to estimate chronic exposure relies on a hypothesis of independence between the different days. Whereas it is relatively easy to collect data on non-consecutive days using a recall method, the inclusion of independent days in a dietary record is more complicated and expensive.

Concerning the response burden, it is considered high for the dietary record, as recording must be done at time of consumption. In general, respondents must be literate and highly cooperative. This requirement may lead to non-response bias as a result of overrepresentation of more highly educated individuals who are interested in diet and health. A low response rate might be a particular problem in some European population subgroups. In the EPIC study (Slimani *et al.*, 2002) the experience was that the diet record method would not work in Greece and some regions of Spain. In the Netherlands, response to a diet record method is expected to be very low in adolescents and young male adults. Whereas in other countries, like the UK, a comparison study revealed no differences in response rate between recall and record method (Stephen *et al.*, 2009). In the EFCOSUM study (TNO, 2001), the low respondent burden and more general applicability also to subgroups that were less literate were arguments why a 24-hour recall method was preferred over a dietary record method (Biro *et al.*, 2002). Especially a weighed diet record is considered to have a high respondent burden and is therefore inappropriate for the current purpose; whereas the administration time of the recall is short (20-40 minutes), literacy is not required, and the open form is not culture specific (Biro *et al.*, 2006). Response rates are usually rather high with recalls, although some specific subgroups, e.g. low socio-economic status groups, might always be difficult to reach, irrespective of the method.

Concerning the applicability of the methods for the different population groups, the record is suitable for young children (up to 7 years old) as parents or caretakers can function as surrogate respondents. Some concern may persist concerning the reliability of records on out-of-home consumption. There may be several caretakers within one day (Livingstone *et al.*, 2004). The recall is considered less reliable for out-of-home consumption (Klesges *et al.*, 1987) compared with the record. Since young children (<7 years) have a limited ability to co-operate in dietary assessment, the ability of parents to accurately recall their children's food intake is vital (Livingstone & Robson, 2000). Parents may reliably report the dietary intake of pre-school children, but once they begin attending school, parents do not always know what their children eat outside the home. Thus, the suitability of parents to be the only informants of their child's intake is inevitably limited and this must be considered as a major limiting factor in studies using recall methodology in children. With respect to very elderly people, the dietary record method is suitable but needs adaptations similar to those needed for children, whereas the recall is considered inappropriate because of the cognitive decline often experienced by the very elderly persons.

The dietary record is less suitable than the 24-hour recall for subjects with low literacy rate (Biro *et al.*, 2002). This could be relevant in the case of populations in low socio-economic conditions such as immigrants from different ethnic groups.

Concerning the standardisation of the data collection, interviewers need to be thoroughly trained for the dietary record method and quality checks should be part of the study protocol to improve

standardisation. No software has been used so far to enable highly standardised dietary records across EU countries. As it is more extensively discussed in section 5.2 of the Guidelines, software is available to enable highly standardised 24-hour recalls (e.g. EPIC-SOFT) (Slimani *et al.*, 1999), although extensive training and checks are still needed. For both methods, the EGFCD agreed that detailed instructions are necessary for the subjects and standardised procedures need to be followed by both subjects and interviewers in order to obtain the required level of details and quality.

Concerning the efficiency/cost ratio, the additional costs for extra (consecutive) days for a participant are relatively low; while additional costs for non-consecutive days and for extra participants are relatively high for both methods. The EGFCD concluded that the main reason in favour of the recall method as a less expensive method was the possibility of replacing visits at home by a telephone call in order to administer the interview.

Concerning the validity of the methods, the usual eating pattern may be influenced or changed by the recording process and participants might forget to record some foods. In order to allow the calculation of the intra-individual variability, subjects must record consumption for at least three days. Although not strictly independent, the first and third are non-consecutive days.

The validity of the 24-hour recall method mainly depends on the respondents' short-term memory. When the recall is announced subjects can reduce their consumption and produce a bias. The method is vulnerable to variability between interviewers.

The accuracy in the quantification of the consumed portion sizes is higher for the dietary record over the 24-hour recall but only if these are measured or weighed. Moderate underreporting occurs for both methods, particularly in some subgroups (e.g., obese persons) (Livingstone and Black, 2003).

3.6. Number of replicates in 24-hour recalls or dietary records

In order to estimate acute exposure it is sufficient to record food intake for only one day, including details of the foods consumed per meal and details on the time of each eating occasion. However, food consumption data for several days per subject are required in order to assess chronic exposure. At least two independent days are needed to apply statistical modelling to estimate habitual intake (Dodd *et al.*, 2006).

Table 1 shows that the number of replicates (days) per subjects varies in national dietary surveys, with five surveys having only one day and four having seven days. The number of days per subject and the number of subjects included in the dietary survey are correlated since they are both limited by the amount of financial resources available. From a statistical point of view it is more efficient to extend the number of participants rather than the number of days. On the other hand, it can be more efficient to include more recording or recall days per person in order to estimate habitual exposure to compounds present in less frequently consumed foods. However, the availability of information on the consumption frequency can reduce the need for having more than two days.

It is relatively cheap to increase the number of consecutive days when using the dietary record method, whereas it is expensive to increase the number of non-consecutive days. When using the dietary records technique, accuracy of records may decrease as the number of days increases (Biro *et al.*, 2002), in practice no more than three or four consecutive days should be included because of respondent fatigue (Gersovitz *et al.*, 1978).

The EGFCD recommends the collection of dietary information for two non-consecutive days for both the 24-hour recall and the dietary record methods. Days are considered as non-consecutive if there is at least two weeks interval between them. In any case, more than three days are not recommended in order to limit the respondent burden and a potentially high non-respondent bias.

3.7. Additional food frequency questionnaire

The EGFCD advises to collect specific information on the frequency of consumption using a food propensity questionnaire (FPQ). This questionnaire does not need the inclusion of questions on portion sizes, because this information can be used from the diet records. The frequency information can then be used as a covariate to model the estimation of usual intake (Dodd *et al.*, 2006). In order to limit the respondent burden it is advised to limit the length of the questionnaire. Foods included should be those that are consumed episodically and with likely higher concentrations of relevant biological agents or chemical substances. The EGFCD recommends consulting the different EFSA Scientific Units with respect to the selection of the foods to be included in the questionnaire.

3.8. Conclusions and recommendations in the case of children

As stated in the Introduction section of the Guidelines, infants and toddlers are the population groups with the highest priority within the risk assessment process conducted by EFSA. The EGFCD recommends that the dietary record method including two non-consecutive days is applied to infants, toddlers and other children (from 36 months to 10 years of age). This is considered the most appropriate method and the main reason in favour of this choice is that this method facilitates a combination of parents and (various) caretakers in recording the foods and beverages consumed, depending on the location of the child. Non-respondent bias, which could occur due to the higher respondent burden of the record method, is probably less of a problem in this population group since response rates in studies among children are generally higher compared to other population groups. For the purposes of EFSA it is important that an open method is used where all consumed foods can be recorded and described in detail. For some relevant food groups, the details might include the brand name. This needs to be worked out at the food group level. A written and face-to-face explanation is needed to teach the parent/caretaker on how to fill in the diaries. It is recommended that after the first day of recording the parent/caretaker is visited to check and complete the diet records and that immediately after completion of the records the whole diary is checked in detail again and completed when necessary. This greatly improves the quality of the data.

Detailed protocols concerning the administration of the dietary record method in infants, toddlers and other children (from 36 months to 10 years of age) must be elaborated before starting the collection of the food consumption data.

3.9. Conclusions and recommendations in the case of adults

Doubts persist whether the dietary record method is also the best choice for a pan-European dietary survey for adults. It would be a logical choice aimed at a methodology standardisation across age groups. However, the use of the dietary record method might negatively influence the response rate and consequently the representativeness of the food consumption data. As more extensively discussed in section 4.1.2 of the Guidelines, the 24-hour recall can be conducted by telephone, which would greatly reduce the costs compared to a study involving interviews at the participant's home. Non-consecutive days using a recall method would better capture intra-individual variability than the use of consecutive days for the records method. However, the level of details seems to be lower with a recall than a records method.

The EGFCD concluded that both methods are suitable to be used for adults within a pan-European dietary survey, each method having its specific pros and cons. However, the EGFCD considers it essential that the same method is applied in each country within a pan-European dietary survey.

The EGFCD therefore recommends that the 24-hour recall method including two non-consecutive days is applied to the adult population. This is considered the most cost/effective method and the main argument in favour of this choice is that the 24-hour recall can be better implemented within a pan-European dietary survey in order to increase the number of subjects and the participation rate, as more extensively discussed in the other chapters of this document. The possibility of implementing the food record method in the adult population is considered particularly problematic in some of the countries.

The main problem is the presence of a significant percentage of illiterate people in some of the Member States. Illiteracy is particularly an issue in ethnic minorities all over the European Union.

Detailed protocols concerning the administration of the 24-hour recall method in the adult population must be elaborated before starting the collection of the food consumption data.

4. Administration of the interview

From the literature, the face-to-face method at the participant's home was the most commonly cited method used for obtaining consumption data as part of large dietary surveys. However, some national studies are considering other methods in current and future studies, such as telephone and web based interviews, at least for sub-samples of the population.

4.1. Interview options

4.1.1. Face-to-face

The main advantages of the face-to-face interview are that it allows for better rapport; the more personal relationship may increase response rate due to personal contact with the interviewer and there is a potential for more detailed probing of participant responses. When the face-to-face interview is held at home, subjects can show the interviewer actual food packaging or foods that were consumed in order to better identify them (i.e. brands, organic foods etc) and allow a pantry check or to get some information about the fridge management.

The main disadvantages of the face-to-face interviews are that collecting dietary data from large samples is time-consuming and expensive; the body size of the interviewer and of the subject may be an issue and affect the responses of the participant. In person, the subject may be more vulnerable to exaggerate consumption of foods they perceive to be good and underreport foods perceived to be unhealthy.

4.1.2. Telephone administered interviews

The increasing popularity of the telephone interview as a research method may be a reflection of broader social change and technological advances, with increased use and acceptability of telecommunications. Telephone ownership in Western societies has grown to >90% of households. This method can be used on its own or in combination with face-to-face interviews and questionnaire surveys and interview schedules can be structured or semi-structured.

Traditionally, the 24-hour dietary recall has been performed by a face-to-face interview, but interviews being conducted by telephone have become increasingly common and are considered as a feasible alternative to expensive and often time-consuming face-to-face methods. There is good support in the literature for the telephone interview as a legitimate data collection method for research. Several studies have concluded that telephone and face-to-face diet recalls tend to be interchangeable. It has been indicated that well designed and well administered telephone surveys are as good as other dietary assessment methods. For example, in the US, traditionally the Continuing Survey of Food Intakes by Individuals (CSFII) has been conducted using face-to-face interviews. However, at the beginning of 2001 the USDA started to collect all dietary data by means of telephone interviews. In summary, among both adults and children, information from dietary recalls is similar whether obtained by person or by telephone, although under-reporting for all methods is evident when compared to doubly-labelled water.

The main advantage of a telephone-administered interview is saving time and therefore saving money in large national surveys. The use of telephone interviews for large-scale studies may decrease costs by as much as 75% compared to other methods and increase access to remote regions (Casey *et al.*, 1999). It allows for centralised training and supervision of interviewers and for increased speed of data gathering and processing. Sampling is not geographically restricted so this method is particularly useful where geographical location could be a barrier to face-to-face interviews. It is suggested that a telephone interview may be more objective than via face-to-face as the telephone removes some of the psychosocial variables that are present with face-to-face contact. The subject may be more open and honest while speaking on the telephone without the physical presence of the interviewer. Telephone interviews offer a better alternative to mailed questionnaires because interviewers can clarify questions

and probe. Also response rates are likely to be higher than for mailed questionnaires (although maybe not for face-to-face).

The main disadvantage of the telephone-administered interview is that the personal touch is lost, but the use of probing techniques by the skilled interviewer can considerably reduce the amount of under-reporting. For best results, a picture booklet needs to be designed and provided to all participants prior to the telephone call. One concern about telephone interviews is non-covering bias due to the exclusion of subjects without a telephone. Also, there might be a lack of visual cues to aid the participant's memory. Other issues such as hearing impairment, language barriers, illness and fatigue especially in the elderly will be enhanced during the telephone call. Additional data such as anthropometry cannot be measured.

Another issue with telephone interviews versus face-to-face interviews is response rates. Response rates have been found to be best in telephone interviews where face-to-face recruitment had taken place (Carr & Worth, 2001). Design strategies for telephone interviews suggest that introductory statements made by the interviewer are crucial in ensuring a good response rate, with refusal to participate most likely to be in the initial phase (Barriball *et al.,* 1996).

Numerous studies (Posner *et al.*, 1986; Derr *et al.,* 1992; Lyu *et al.,* 1998; Casey *et al.,* 1999; Tran *et al.,* 2000; Bogle *et al.,* 2001) have investigated the reliance and use of the telephone as a method of interview for dietary assessment purposes. The main conclusion from these studies is that in all cases the telephone method provided a reliable and cost-effective alternative to a face-to-face method, with similar response rates being observed for both methods. In general, it is advised that food photographs should be sent out to participants in a telephone interview in advance to help estimate intakes.

Baxter *et al.* (2003) compared the accuracy of dietary recalls from 4th-grade children given by telephone interview within-person recalls. Results indicated that the accuracy of children's dietary recalls of school breakfast and school lunch did not differ significantly. This result allows for both interview modalities to be utilized in a single study without compromising the ability to compare children's accuracy. However, regardless of the method of interview, children failed to report 1/3 of items they were observed eating at school breakfast and lunch, and also almost 1/5 of items they reported eating at these 2 school meals were not observed eaten.

Brustad *et al.* (2003) compared the use of a standardised computer program EPIC-SOFT with either a face-to-face or a telephone interview with a 24 hour-recall design in Norwegian women. A quantification booklet was mailed to those doing the telephone interview. They found no statistically significant differences in reported dietary intakes between subjects interviewed by telephone or face-to-face, except for 'egg and egg products' of which intake was higher in the telephone group. Their major conclusion was that the EPIC SOFT 24hr recall can be administered by telephone or in-person interviews without significant difference in estimated intake. The crude response rate was higher for the face-to-face interview compared to the telephone interview (69.4% *vs.* 60.6%).

4.1.3. Postal and web based surveys

There are not as many studies in the literature that have examined postal questionnaires as a method of obtaining dietary information as there has been for the other methods. In general it seems that both face-to-face and telephone interviews are superior for obtaining dietary and health data compared to postal questionnaires, but that certain sub-populations may have different response rates to different methods.

New computer-based technologies (i.e. the internet) and combinations of qualitative and quantitative methods are now being used for dietary assessments. Technology is changing how dietary assessment methods are being delivered. Although web-based assessments are more accessible and they enable larger nutritional epidemiological studies to be conducted, validation and calibration of these new

methods are needed to fully utilise this new frontier in dietary assessment methodology. The EGFCD welcomes initiatives to further develop web-based tools in the area of dietary surveys.

4.2. Place of interview

In choosing the place of interview, several factors have to be taken into account such as: type of survey and survey methodology employed, information sought, number of interviewees, number of interviews to be conducted per interviewee, survey population, size of survey area to be covered, accessibility, seasonal influences, availability of interview locations other than participant's home, availability of trained interviewers, transport and cost.

Hence the decision on location of the interview is multi-factorial. Nowadays, most nutrition/diet surveys include additional information such as health status, physical activity, etc and may include the collection of biological samples. In such cases, additional resources might be required to collect such samples. Also, information on diet/nutrition is sometimes collected as part of surveys primarily focusing on different aspects, such as health status, and again, the place of interview will largely depend on the type of information sought.

For example the National Health and Nutrition Examination Survey[8] (NHANES), conducted in the United States requires an initial home interview followed by a visit to a mobile examination centre, which contains all diagnostic equipment and personnel necessary to conduct a wide range of both (simple and complex) physical and biochemical evaluations (US NHANES, 2007). On a smaller scale, in Italy, for the CHIANTI study (Invecchiare in Chianti, "aging in the Chianti area"), interviews were conducted at the participant's home followed by an assessment in a study clinic (Ferucci *et al.*, 2000). Whereas NHANES covered a vast area and used mobile centres for that reason, the Chianti area was a defined area and travel to clinical centres was therefore possible. On the other hand, the 1994-96 US Continuing Survey of Food Intakes by Individuals (CSFII) and the Diet and Health Knowledge Survey (DHKS) were performed largely in the participant's home with some minor percentages being followed up by telephone (US CSFII 1994-1996, 1998). Smaller studies, such as method validation studies, or studies on specific population sub-groups are often conducted outside the home, such as in clinical settings, research centres, defined locations (student accommodation, nursing homes, schools), etc (Acheson *et al.*, 1980, Todd *et al.*, 1983, Savaya *et al.*, 1996, Welten *et al.*, 2000, Erwin *et al.*, 2001, Godwin *et al.*, 2001, Baxter *et al.*, 2002, Brunstrom *et al.*, 2008)

The EFCOSUM (De Henauw, 2002) group found that 13 out of 21 countries involved in the project preferred a home visit as the first choice to collect valid dietary data, as this method offers the advantage of having the opportunity for specific measurements and access to packages of specific foods at home, if needed, and indeed surveys in many countries follow this approach (Harrington *et al.*, 2001, Ocke *et al.*, 2008, NDNS, 2004, Volatier, 2007). However, the conduction of interviews in a central research unit was also considered an acceptable and, probably, more cost-efficient alternative (De Henauw *et al.*, 2002). EPIC reported that in 8 of 9 participating countries, interviews were conducted face to face in the collaborating research centres (Riboli *et al.*, 1997). The only exception, Norway, opted for a telephone interview, due to the wide geographical distribution of participants throughout a sparsely populated country (Brustad *et al.*, 2003)

4.3. Interviewer

The interviews can be administered either by a trained interviewer or by a nutritionist/dietician. However, if trained interviewers are used, then perhaps monitoring and routine checking of their dietary interviews by a registered nutritionist/dietician during the survey period would be important;

[8] http://www.cdc.gov/nchs/data/nhanes/nhanes_07_08/overviewbrochure_0708.pdf

indeed, establishing quality control is critical in ascertaining whether interviews are conducted according to protocol. Audio-recording each interview has also shown to be a good method to ensure that any interview can be randomly selected for quality control checking thus, encouraging interviewers to follow the protocol (Shaffer *et al.*, 2004).

Computerised dietary assessment is an area of growing interest. In the literature there are many studies (Kohlmeier *et al.*, 1997; Bakker *et al.*, 2003; Slattery *et al.*, 2008; Probst & Tapsell, 2007; Probst *et al.*, 2008) that have examined the use of computer software to assist in the dietary interview (see section 5.2 of this document).

Software allowing the self-administration of a 24-hour recall also exists; this means that the recall could be performed by the subject alone through the web and without the support of an interviewer. An example of this software is the ASA24[9] developed by the National Cancer Institute (NCI) in 2004.

4.4. Conclusions on the administration of the interview

The face-to-face method of interview was the preferred option chosen by the EGFCD. The organisation of the dietary assessment interview in terms of number of visits and type or combination of interviews depends on the survey method. If a diet record is carried out, then at least two face-to-face visits are needed according to the EGFCD: one at the start of the survey period and another at the end, to ensure that the record was completed accurately. If the survey is longer than 3-4 days, then a 3rd visit would also be recommended. Although a telephone interview during the survey period would be acceptable, it could only be used to motivate the subject and to ensure the smooth running of the data entry into the food record. In the case of a 24-hour recall, this would be preferably carried out face-to-face, at least in the first interview. Following the first interview, the EGFCD recommends that further 24-hour recalls are administered via telephone interview.

The choice of interview place depends on a multitude of factors, hence, it is subject to costs, resources and information sought. The EGFCD agrees that in large population surveys the home visit is the most popular choice of location; it offers the advantage of collecting additional information on foods consumed, such as packaging, and will allow for direct weighing of some items. The collection of part of this information, however, is also possible if particular sub-sections of the population are examined in particular settings, such as school canteens, examination centre etc. Therefore, in particular conditions as in remote areas, the EGFCD finds it acceptable that the interview takes place outside home.

The EGFCD prefers that nutritionists/dieticians conduct the dietary interview. However, other interviewers are accepted, as long as they are adequately trained in the method of dietary assessment to be used.

Detailed protocols concerning the harmonised conduct of the dietary interview across different countries must be elaborated before starting the collection of the food consumption data.

[9] http://riskfactor.cancer.gov/tools/instruments/asa24/#background

5. Dietary survey tools

5.1. Determination of portion sizes

One of the main errors that occur while measuring food consumption in dietary epidemiological surveys is the assessment of portion size (Turconi *et al*, 2005); hence, measurement tools have to be selected carefully.

The methods used to quantify portion size can be divided into two broad categories: those where foods and leftovers are weighed respectively before and immediately after consumption and those where food portions are estimated. Weighing before and after eating is considered to be the most accurate method for measuring food intake. The disadvantages of this method, called 'the weighed method', are that it is time consuming, costly and disruptive (Wolper *et al*., 1995) and there are many circumstances in which scales may not be available. Weighing each food item can also introduce changes in eating habits; there are circumstances where weighing is not suitable, for example in large epidemiologic studies (Nelson *et al*., 1996). Furthermore, there is a risk that when participation in a project requires a great deal of subject commitment, the response rate will be low (Berg *et al.*, 1998).

As an alternative to weighing all food items eaten, consumption can be measured based on the subjects' estimates of portion size.

5.1.1. Portion-size measurement aids (PSMAs)

There are a number of measurement aids that can be used while estimating food intake which help to avoide common errors in assessment of portion sizes (Guthrie, 1984). Such aids, frequently referred to as portion-size measurement aids (PSMAs) including photographs, food models, household measures, rulers etc, have been used separately or in combination in dietary data collection (Pekkarinen, 1970, Slimani *et al.*, 1999, Chambers *et al.*, 2000, Harrington *et al.*, 2001); although there is general consensus that no "gold standard" as such exists for estimation of portion size (Frobisher *et al.*, 2003, Wrieden *et al.*, 2009). All established approaches have advantages and disadvantages that have been recently summarised by Wrieden and Momen (2009).

Systematic bias and large random error may occur while quantifying foods; therefore, as it is accepted that there is no perfect way of measuring habitual intake, the method selected for each study will depend on several factors, which include convenience for the subject, degree of accuracy required, expense (Kemm *et al.*, 1992) and target population (Foster *et al.*, 2009).

It is inevitable, however, that inaccuracies in portion size assessment will remain. These errors will lead to misclassification of subjects according to the amount of food consumed. The degree of misclassification can be reduced only if the components of the error are fully described. Portion-size validation studies are aimed at determining the level of precision (Smith, 1994) and at identifying food items whose reliable measurement is difficult (Nelson *et al.*, 1998); they can be useful to improve the analyses of dietary data.

A number of validation studies have been conducted to test suitability of portion size aids and some have tried to characterise magnitude and direction of errors encountered. Unfortunately, due to different methodologies employed, no direct comparison between the studies is possible and results are conflicting.

Another controversial topic concerns the effect of subject characteristics on reporting ability with conflicting findings in many cases. A number of studies found no significant gender-related differences in ability to estimate amounts of food eaten (Wein *et al.*, 1990, Faggiano *et al.*, 1992, Haralsdottir *et al.*, 1994, Young *et al.*, 1995, Robson *et al.*, 2000, Ervin *et al.*, 2001, Turconi *et al.*, 2005). Ovaskainen *et al.* (2008) and Nelson *et al.* (1996) however reported an effect of gender on the portion-size estimation. Williamson *et al.* (2003) cites a number of studies showing that dietary intake reports from obese people, white women, and individuals from lower socioeconomic groups have been

found to underestimate food intake. In contrast, two Italian studies suggested that age is not an important predictor of ability to estimate food quantity accurately (Turconi *et al.*, 2005, Faggioni *et al.*, 1992) and others have concluded that level of education is also unimportant (Ervin *et al.*, 2001, Webb *et al.*, 1990). Baxter (2009) found that reporting accuracy in children was related to their age/sex BMI percentile, but there seems to be little evidence for any correlation between socio-economic status and basic pattern vision (Farah *et al.*, 2006).

No overall tendency for over or underestimation can be found in the literature, as divergent observations are reported. Some studies have shown a general tendency to underestimate and underreport food portions (Ovaskainen 2008, Karvetti *et al.*, 1985), while other studies stated the opposite (Nelson *et al.*, 1996, Frobisher *et al.*, 2003, Hernandez *et al.*, 2006) and finally Robson and Livingstone (2000) demonstrated no trend for over or under estimation at all. The actual size of the portion may have a significant effect on the amount of under/over estimation of portion weight. A number of studies report effect of portion sizes on magnitude and/or direction of reporting error (Nelson *et al.*, 1998, Ovaskainen 2008, Chambers *et al.*, 2000, Lucas *et al.*, 1995, Hernandez *et al.*, 2006). Generally, small portion sizes are overestimated and large portion sizes underestimated.

When older persons are being considered, information on diet is usually collected using instruments that had been originally developed and validated for middle-aged populations. Whether the same instruments administered to older persons provide reliable and valid data is questionable (Van Staveren, 1994).

The combination of aids for quantitative estimation is frequently used or recommended (Harrington *et al.*, 2001, Frobisher *et al.*, 2003, Ayala *et al.*, 2006, Matthiesen *et al.*, 2003, Menink *et al.*, 1998, Haralsdottir, 1999). For example, portions of bread have been poorly recognised from pictures (Frobisher *et al.*, 2003, Ovaskainen 2008); it possibly occurred because food portions presented in the pictures may be difficult to conceptualize, or because of a wide variety in the types of rolls and loaves and in their thickness, and cereal ingredients. Several authors recommended that traditional food models should be used as aids for portion-size estimation in frequently consumed food items, such as bread alongside photographs (Slimani *et al.*, 1999, Ovaskainen 2008, Bodner *et al.*, 2003, Chambers *et al.*, 2000, Lucas *et al.*, 1995). Bodener et al (2003) reported that Americans used a variety of methods in addition to a 2D Food Model Booklet to estimate their portions of food and beverages, thus it was important to provide many different options to the interviewee when assessing dietary intake. Such methods included standard units, such as fluid ounces and weight, measuring cups and spoons, ruler dimensions and descriptive phases such as brand names and relative sizes.

The most frequently tested method appears to be the use of photographs. A number of studies reported the benefits of using photographs to help individuals in estimating portion size, they are commonly used as a PSMA (Turconi *et al.*, 2005, Ovaskainen 2008, Lucas *et al.*, 1995, Faggioni *et al.*, 1992, Robson *et al.*, 2000). According to some studies (Frobisher *et al.*, 2003, Hernandez *et al.*, 2006) a "reasonable range" for acceptable portion-size estimation is recommended. Ovaskainen et al (2008) indicated a decrease in estimation error with increasing portion options and Lucas et al (1995) suggested having more than three portion-size alternatives in the photographs. Turconi *et al.*, (2005) found photographs presented in three portion sizes, allowing also virtual portions to be chosen up to a total of seven, as an appropriate approach to estimate food consumption in agreement with other authors (Faggiano *et al.*, 1992, Navarro *et al.*, 2000). He further suggested that coloured pictures may be more attractive than black and white ones. Ovaskainen et al (2008) found that ambiguous photographs, such as a photograph with two portions on the same plate for two rather different food items, might be misleading for the study subjects.

Since errors do occur when using photographs, one may wonder whether other quantitative methods perform better. Unfortunately, data relevant to this issue are very scarce. Providing aids in the form of photographs, other two-dimensional representations, or three-dimensional models seem to yield similar results (Kirkcaldy-Hargreaves, 1980, Posner *et al.*, 1992). Error variability seems to be reduced when photographs and food models are used together, compared to using household measures alone

(Rutishauser 1982). Also the photograph method appears to provide better estimates than in the absence of visual aids. Concerning assessments not using a visual aid, Bolland *et al.* (1985) and Guthrie (1984) respectively found that in 14% and 67% of the cases the food portion size was over or under-estimated by more than 50%.. However, some studies suggest that the use of PSMAs are not the most effective tool for certain types of food, such as muffins and highly irregular shaped meats (ribs), and the use of pre-determined standardised weights based on portion size categories would be more beneficial (Godwin *et al.*, 2001 and 2006, Mc Guire *et al.*, 2001).

It is obvious that several errors can come up in diet interviews owing to methodological aids, memory, and attitudinal effects. However, regardless of the measurement aid methodology used, the accuracy of the method with regard to portion size needs to be validated and examined periodically. This is necessary because of the changes taking place in packaged food and food selection among population groups. A number of studies have shown that portion sizes, including portion sizes of manufactured foods have increased substantially over the last decade, and that choice of food products has widened (Matthiesen *et al.*, 2003, Kerr *et al.*, 2005, Young *et al.*, 2003, Smiciklas-Wright *et al.*, 2003). Young and Nestle (2003) found that, with the single exception of sliced white bread, all portions of the commonly available food they measured exceeded, sometimes greatly, USDA and FDA standard portions.

In addition to traditionally used methods, such as photographs, household measurements and food-models, newer technology is under development (Kubena *et al.*, 2000, Williamson *et al.* 2002), such as digital imaging, etc, and their suitability still needs to be explored.

5.1.2. Special consideration for children

Very few studies have been conducted with children to investigate the problems they may have in portion size estimation. Foster *et al.* (2008) suggests that issues such as literacy and writing skills, limited food recognition skills, memory constraints and concentration span may affect children. Frobisher and Maxwell (2003) found greater errors in both accuracy and precision of portion size estimates made using food photographs when children were the subjects, however, the latter study used photographs of typical adult portion sizes. The authors (Frobisher and Maxwell, 2003) further reported that the portions for some foods considered by children to be small were significantly smaller than those deemed to be small by adults; this would suggest that a different set of estimated 'small' portion sizes should be used for children, not adult data. This was confirmed by Foster *et al.* (2008) who found that whilst the accuracy of estimates of food portion size made by children using adult food photographs was poor, children were able to estimate a portion size with accuracy approaching that of adults when provided with food images of age-appropriate portion sizes.

Foster *et al.* (2008) also demonstrated that children are able to use portion size assessment tools to estimate portion size as young as 4–6 years old, although precision and accuracy of estimates improved with age using different tools. The authors further cite that the increase in the accuracy of estimates between the ages of 7–11 and 11–14 years are in line with theories on size perception. Perceptual abilities that would be expected to increase a subject's accuracy in estimating portion size include conservation. Conservation is the ability to recognise that a size or quantity remains the same when the appearance of the object changes (Foster *et al.*, 2008). The ability to conserve develops at about 7 years of age. A specific example of how this relates to portion size estimation is that children younger than 6 or 7 years of age will usually say that a tall thin container holds more liquid than a short broad container when both containers actually hold the same amount.

Both Foster *et al* (2008) and Warren *et al., (2003)* found that leftovers were not readily reported by young children and that in assessing dietary intake it is important to assess the portion size of foods actually consumed rather than those served. Foster *et al.* (2008) tested 3 different measurement aids in children and found food models to be the least accurate and precise of the three methods, whereas photographs and an interactive tool performed similarly. Mattheson *et al.* (2002) compared a novel

portion-size measurement aid for children with standard 2-dimensional food portion visuals and found both estimates to be of similar accuracy when compared with actual intakes.

5.1.3. Conclusions on the determination of portion sizes

No gold standard exists for estimation of portion size. The use of different aids will depend on survey methodology, target population and accuracy required. Estimation of portion size is a complex matter and has been subject to much debate, with lots of conflicting outcomes. There appears to be consensus that the parallel use of different PSMAs is appropriate to obtain best estimates for different foods. The EGFCD stressed the importance of using age-appropriate tools and portion size aids which are representative of the food available on the market and of the food portions actually consumed.

The EGFCD recommends the use of country-specific and validated picture books. These books should contain pictures of foods in portion sizes that represent the area where the study was conducted and should include foods commonly available on the market at the time of the survey. Furthermore, it should contain pictures of household measurement tools and standard units e.g. for eggs, apples etc. Photos should also depict a ruler for indication of scale. The use of age-appropriate tools is particularly important when children are the target population. In this case, a broader range of small portion sizes should be included together with portion sizes suitable for estimation of leftovers. To avoid regression towards the mean, a minimum of 4 colour pictures should be used, pictures should be of same shape and size and taken at the same viewing angle. This angle may vary for children. Each photo should only depict one portion size.

Manufacturer's information should be used when available. For certain foods, such as foods where portion size can be obtained from manufacturer's information, the use of a picture book is not needed. Such foods include confectionery (chocolate bars, etc), serving size packets of potato chips/crisps and other savoury snacks, tins/cans of food or beverages, franchised fast foods, pre-packaged foods for which weights are available from the packaging etc.

Regardless of the measurement aid methodology used, the suitability and accuracy of the method needs to be validated and examined periodically.

5.2. Dietary software

In a pan-European dietary survey, data collection should be performed in a standardised way. Software should be used to collect dietary data comparable between countries. This software program should therefore ensure the highest possible level of standardisation of the interviews within and between countries, and increase the likelihood that, if measurement errors exist, they will apply equally in all centres.

Despite increasing interest in the concept of calibration in dietary surveys, there is still little experience in the use and standardisation of common reference data collection software, especially in international studies.

One of the problems of standardising a dietary recall or a record method lies in their open ended nature. It is not known beforehand what the subject will report, and the interviewer or the person in charge of the data input needs to know all the rules for identifying correctly, describing, quantifying and checking the thousands of foods or recipes that may be reported. This problem is maximised in large studies such as in national food consumption surveys and it would be even more significant in a pan-European dietary survey.

5.2.1. Principal characteristics of the dietary software

The collection of individual food consumption data into a centralised national database and from there into a European centralised database is necessary for assessing data quality, the success of the standardisation, and to allow inter-country comparisons. These are a prerequisite for meaningful

comparisons of the survey results among countries. Collection of the data in one database also facilitates the joint analysis and reporting of data.

The central coordination unit should prepare a system to assist the countries in inputting food consumption and related information in a harmonised way and in transferring this data to the central database. This system should allow the data to be checked for accuracy and consistency and to be compressed and encrypted for transfer via Internet. The data transfer and management system must ensure the security and confidentiality of the data.

Dietary software should present specific characteristics in order to be used within a pan-European dietary survey. Information on all foods and beverages consumed during the survey must be entered and coded automatically according to common rules. During the data inputting, it has to be possible that each item is automatically searched, described, quantified and checked using pre-entered common rules. In addition, the software program should guide and control the interviewers by standardising, across countries, the pathways to be followed during the data inputting. The level of description across countries has also to be standardised. Whatever way the food/recipe is quantified during the interview, the system must be able to automatically convert food quantities "as reported" to "as finally consumed" (e.g. cooked and/or without inedible part), using pre-defined algorithms and standard food-specific coefficients (e.g. raw-to-cooked, density or edible part coefficients) which can easily be updated.

Systematic quality controls have to be performed throughout the data input procedure. The system should check systematically for all information reported by the subject and entered into the program so that possible errors and suspicious answers, missing information and outlier values, can be detected and clarified with the subject during or after the survey. It must be possible to re-run accuracy and consistency checks after merging into the European database. Standardised maintenance procedures for the different databases must be ensured. Like any open-ended method, the databases need to be updated regularly so that new foods, recipes and other information reported by the study subjects can be added. To maintain a high level of control and standardisation of the different databases and to facilitate updating, it is important that only one version is available in each country and that any modifications to the country specific files are centralised at country level and at European level. The program must provide output files with valid population food, energy and, hopefully, macronutrients intake data in electronic format. These output files must be functional to perform statistical analysis. The software must allow storage, output and export of the different databases in a standardised way

The EGFCD recommends that the following mandatory databases are implemented in the software program: portion size, standard recipes, food composition, food supplements composition, yield factors, brand and packaging information (the last two collected on certain foods and beverages only). The following optional databases could additionally be included in the software program: energy requirements and retention factors. All these databases must be developed at country level. It will also be mandatory that the software includes food descriptors and facets applicable to a common food classification system being developed by EFSA.

5.2.2. Existing dietary software

The EPIC-SOFT program, developed by the International Agency for Research on Cancer, was recommended by EFCOSUM as the first choice to collect food consumption data in future pan-European monitoring surveys. Following this recommendation, EPIC-SOFT has already been used in 3 national dietary surveys in The Netherlands (Ocke *et al.*, 2005), Belgium (Enquête de consummation alimentaire Belge 1, 2004) and Germany (Nationale Verzehrstudie II, 2008). A new version of the EPIC-SOFT and the concept of its related management platform are expected from the outcome of the EVCOVAL project (March 2010).

EPIC-SOFT covers most of the above mentioned characteristics and could be used within a pan-European dietary survey. It has been developed for dietary surveys conducted using the 24-hour recall

method, but it has also been used in the Netherlands as a data entry system for dietary records during a dietary survey of children (Ocke *et al.*, 2007). Due to its intrinsically flexible structure, it is possible to easily make changes to the common rules applied to standardise the overall procedure of the 24-hour interview, and to develop further national versions.

EPIC-SOFT is the only dietary software that has been used in different European countries for national dietary surveys. So-called *in-house* software were developed in a variety of EU Member States, such as Italy (Leclercq *et al.*, 2008), Finland (Korhonen *et al.*, 2003) and Ireland (Harrington *et al.*, 2001). However, none of these programs have been used outside the country where it had been developed. Software already used in a national food consumption survey can be a valid alternative to EPIC-SOFT when applied to a pan-European dietary survey. However, this would require time and resources to develop the country specific versions of the software and to ensure the high standardisation level that can be obtained by the EPIC-SOFT program.

The American Food Information Analysis (FIAS) program, developed by the University of Texas - School of Public Health and by the US Department of Agriculture, for example, was adapted and used for the Negev Nutritional Study in Israel. Furthermore, FIAS has been used to analyse dietary intake data from Iran, Lesotho, Southern Africa, Guam, Mexico and Egypt.

The EGFCD agreed that a unique computerised interview or data input software is necessary to guarantee standardisation across countries in the procedures for data input and for controlling sources of error attributable mainly to the respondent and the interviewer.

The EGFCD agreed that the EPIC-SOFT program would be the best possible solution to collect dietary data within a pan-European dietary survey. However, its use is subject to a long-term agreement with IARC. The EGFCD recommends EFSA to collaborate with IARC in the view of a pan-European dietary survey but, in case this would not be possible, an acceptable alternative would be the adaptation of existing dietary software.

6. Non dietary information and quality control

The core objective of a pan-European dietary survey is the collection of food consumption data at individual level. Therefore, the collection of non-dietary information should be reduced to the minimum in order to reduce costs and to ensure a sufficient response rate by limiting respondent burden to the minimum. For that reason it is crucial to identify non-dietary information that is essential and to select procedures and tools that reduce the required time. In this regard and as already stated in section 1.4.3 of the Guidelines, it is necessary to identify subjects with special dietary patterns due to either their personal choice (e.g. vegetarians) or to health problems (e.g. diabetics, celiac people, etc.). Information on ethnicity or socio-economic status is also desirable since these two variables might be useful to identify consumption patterns. The minimal socio-demographic information needed includes also age, gender, region, rural/urban area, household's size, household income and education level.

6.1. Body weight and height

Customarily in exposure assessment, toxicological reference doses of chemical agents are defined as the amount of the substance per unit of body weight per unit of time (e.g. mg/kg body weight per day). Bodyweight should be recorded as part of a dietary survey in order to enable calculation of dietary exposure per kg/bodyweight at individual level for direct comparison with toxicological reference units. Two methods are generally used to record body weight and height in the context of a food dietary survey, namely "self reporting by subjects" or "measured by the interviewer". There is at this time no consensus on the best practice and both methods are used in dietary surveys throughout Europe. For example, in the EPIC survey, Belgium, France (Inca1) and Italy self-reported anthropometric measurements were collected, whereas in the more recent French study (INCA-2) and in the NDNS studies in the UK, height and weight parameters were measured.

Self-reporting is the most frequently used method. It has the advantage of low cost, speed and easy administration and it is suitable for surveys. However, self-reporting is subject to certain limitations. In particular, questions may be misunderstood and participants may not accurately recall past events. In the specific case of weight and height, social desirability or response acquiescence are not uncommon and can bias the response. Social desirability is particularly problematic and changes in question wording have the potential to impact the quality of self-reported estimates. These issues make it difficult to obtain accurate self-reported estimates of height and weight over time (Gorber *et al.*, 2007).

In the Netherlands, Scholtens et al (2006) compared body weight and height of 4-year old children reported by parents versus as measured. They concluded that parents of children with a low body mass index (BMI) tended to over-report body weight of their child, while the opposite pattern was observed for parents of children with a high BMI. Tokmakidis *et al.* (2007) found similar results in Greek school children. The degree of self-report bias was higher for high-school children and heavier children, compared to elementary school pupils and lighter children, respectively. Studies in adults and adolescents, in which participants were asked to report their body weight and height, showed an under-reporting of body weight and an over-reporting of height. However, in adults and adolescents, women were found to under-report their body weight and BMI more than men. Crawley *et al.* (1995) examined the relationship between reported and measured height and weight in a teenage population group. Tall and thin individuals were more likely to under-report their height whereas shorter, heavier individuals tended to overestimate their height and under-estimate their weight. The study concluded that self-reported height and weight data from a teenage population should be used with caution, particularly when classifying individuals by BMI or when using weight measurements to estimate energy requirements. Kuczmarski *et al.* (2001) examined the effect of age (from 20 to above 80 years) on validity of self-reported height, weight, and BMI. The study concluded that the most marked differences in estimates for overweight occurred in the advanced age groups (60 years and older), where reported values tended to underestimate overweight. More than half of the sample of adults older than 60 years over-reported height by approximately 2.5 cm. The difference in over-reporting was not significantly different between men and women for the 3 oldest age groups (from 60 to 70

years, from 70 to 80 years and above 80 years). For men aged 60 years and older, the difference between measured and self-reported weight increased significantly with increasing age.

Unfortunately the costs of actual measurements are often high. The intrusive nature of the measurement (light clothes and without shoes) also might have the potential to impact response rates and may increase modification of diet if subjects are aware they will be weighed. Such measurements often also require special training of interviewers for accurate assessment (Gorber *et al.*, 2007).

In the context of a pan-European dietary survey, the rationale to guide the choice is to reduce the bias linked to between countries differences in self-reporting. Therefore the EGFCD proposes actual measurement of body weight and height in order to collect the most accurate estimations of these quantities. A standard and detailed protocol must be identified among those already used in similar studies. Examples of such protocols for height and weight measurements can be found in the case of adults in the report of the *Feasibility of a European Health Examination Survey* (FEHES, 2009) project for adults, whereas for children, the method described by Walker *et al.*,(2003) is a feasible solution.

6.2. Physical activity

Unhealthy dietary habits and physical inactivity are two risk factors for increased blood pressure, hyperglycaemia, hyperlipidemia, and for other major chronic diseases such as cardiovascular diseases, cancer, and diabetes. Although information on Physical Activity Level (PAL) is not directly needed for the risk assessment work conducted by EFSA, the pan-European dietary survey could be a unique opportunity to collect data on food consumption and physical activity at individual level in a large sample of the EU population. As more extensively discussed in section 6.4.1 of the present Guideline, information on PAL can be used to evaluate the quality of the food consumption data collected within a dietary survey. Knowledge of activity level is needed, at least at the population level, to determine the presence and magnitude of under and over reporting.

Techniques for measuring PAL include Heart Rate Monitoring (HRM), motion sensors (accelerometers), as well as self-reporting instruments, such as activity diaries and questionnaires. It is recognised that each of these assessment methods has its own associated advantages and limitations (Ferrari *et al.*, 2007.). Questionnaires are often the only feasible method for assessing habitual physical activity in large populations, because they are easy to administer, relatively inexpensive, and non-invasive. The other three methods are too demanding in terms of logistical and financial resources to be included in a pan-European dietary survey. However, it must be considered that questionnaires tend to over-report activity levels.

Accurate and reliable assessment of habitual physical activity is particularly challenging if these are of low intensity, not done routinely, or not salient for the study respondent (Friedenreich *et al.*, 2006). Most of the questionnaires available in the literature focus on recreational rather than total activity, probably because it is easier to recall repeated discrete activities that are undertaken for a limited period of time and for which a conscious choice is made prior to engagement. Few questionnaires have been designed to assess overall physical activity at work, recreation and domestic life (Wareham *et al.*, 2002). However, examples of questionnaires considering the full set of activities do exist. Wareham *et al.* (2002) and Friedenreich *et al.* (2006), for instance, developed questionnaires assessing past-year self reported physical activity by taking into account occupational, domestic and recreational physical activity in three different sections. They included a description of the type of activity as well as the frequency, duration, and perceived intensity of the activity.

The EGFCD agreed that a questionnaire to assess PAL should be administered to all participants in a pan-European dietary survey. The feasibility and usefulness of these questionnaires for subjects below 10 years of age still needs to be explored. Ideally, the questionnaire should not be time-consuming and burdensome for the subjects and its main objective should only be the classification of the subjects in broad classes of activities (e.g. low, medium and high). The EGFCD recommends that a validated

questionnaire is used. It is acknowledged that the administration of physical activity questionnaires validated in the specific context and/or population is particularly challenging, due to the high degree of specificity of physical activity. Ideally the pan European physical activity questionnaire should be validated by comparison with an objective method, such as an accelerometer (Ferrari *et al*, 2007; Wareham *et al.*, 2002). Alternatively, the EGFCD considered the option of administering the PA questionnaire only to a sub-sample of the study population.

6.3. Nutritional supplements

As already pointed out in section 1.4.1, detailed information on the respondents' use of nutritional supplements and medicines containing nutrients in the survey would be useful for both nutrient and chemical exposure assessments.

The EGFCD therefore recommends that, when reporting the use of supplements and medicines, subjects should report the supplement name, the brand name, the strength and the amount taken. This would require a separate section in the diary or recall and the development of a specific dataset including nutritional supplements at brand level. The long-term use of food supplements and medicines containing nutrients must be explored by means of ad hoc questions in the food propensity questionnaire suggested in section 3.2 of this document.

6.4. Under- and over-reporting in dietary surveys

It has been observed that under-reporting is a common flaw of food consumption surveys conducted with either 24-hour recalls or individual dietary records. Over-reporting has been associated with food frequency questionnaires while no gross over-reporting was reported with 24-hour recalls or individual dietary records. Little emphasis will therefore be given to over-reporting in the present document since food frequency questionnaires do not suite EFSA's purposes.

Under-reporting has been shown to be correlated to Body Mass Index, age, gender and educational level (Black & Cole, 2001). Thus, in a very large number of surveys obese subjects were more prone to under-report than over-weight or average-weight participants. Under-reporting was observed to be more frequent in males than in females and in elderly subjects than in younger adults. Under-reporting also varies among food categories with a tendency to under-report foods high in fat or in sugar such as spreads (Becker, 1999). Under-reporting could also have a geographical dimension (Harrisson, 2000).

Within a pan-European dietary survey, the comparison of food consumption patterns between countries and between different sub-groups within a country may be biased due to a differential impact of under-reporting. It is therefore important to limit under-reporting as far as possible, and to deal with it in a harmonised way.

When a food consumption database is used to assess dietary exposure, the presence of under-reporting may lead to the underestimation of mean dietary exposure in the population and to the underestimation of the percentage of consumers of some foods high in fat or in sugar. Under-reporting is likely to have little effect on the assessment of high percentiles of dietary exposure per kilogram body weight.

6.4.1. Identification of under-reporters

When the ratio of Energy Intake/estimated Basal Metabolic Rate (EI/BMR_{est}) is very low, the probability that under-reporting occurred is high. Cut-off values for this ratio have been therefore developed by Goldberg (1991) to identify under-reporting in the adult population, either at individual level or at group level, and according to the duration of the survey (number of surveyed days). According to Black (2000a, b), these cut-off points should not be used as such but corrected for Physical Activity Level (PAL). Similarly, cut-off values are available to identify over-reporting.

A variety of cut-off values have been used to identify under-reporting in surveys conducted in adult population in the EU. In Sweden a cut off for under-reporting of 1.2 was derived from Black *et al.*

(1996) assuming a PAL for a chair-bound or bed-bound person (survival limit) and comparing with the average individual EI/BMR over 10 days. The individual EI/BMR was used in the EPIC calibration study performed in 10 European countries (Ferrari *et al.*, 2002) together with a cut off for under-reporting equal to 0.88 derived from Black (2000a) in which the Goldberg equation was adjusted for between and within subject variability. Data published in Goldberg *et al.* (1991), in the case of the estimated BMR and a sample size of around 1000, were used to derive a cut off for under-reporting of 1.53 in Ireland (McGowan *et al.*, 2001), assuming 95% confidence limits and seven days survey, and of 1.51-1.52 in Italy (Leclercq *et al.*, 2009), assuming 99.7% confidence limits and one to four days survey.

Cut offs for over-reporting have been used in Norway (Johansson *et al.*, 1998) and in the EPIC calibration study (Ferrari *et al.*, 2002). In Norway, the average individual EI/BMR over one year, estimated through a quantitative food frequency questionnaire, was compared with the PAL for a sustainable lifestyle. The cut off for over-reporting of 2.4 was derived from Black *et al.* (1996). In the EPIC calibration study (Ferrari *et al.*, 2002) a cut off for over-reporting equal to 2.72 was also derived from Black (2000a). In this case, the Goldberg equation was adjusted for between and within subject variability, and compared with the individual EI/BMR.

No such cut-off has been developed for children even though under-reporting is an issue also in this age class (Livingstone and Robson, 2000). The extent of under-reporting can be quantified at group level by comparing estimated energy expenditure with energy intake. Thus, Rennie *et al.* (2005) analysed the UK National Diet and Nutrition Survey (NDNS) and observed that under-reporting represents 21% and 22% of energy needs in girls and boys, respectively. In the last Italian food consumption survey, energy intake was compared to energy expenditure in the different age and gender classes of children and it ranged from 98 to 103% (Leclercq *et al.*, 2009). Information concerning measurement of energy expenditure and physical activity in children are likely to be available in 2011 through the DG Research founded project "Identification and prevention of dietary- and lifestyle-induced health effects in children and infants"[10] (IDEFICS).

6.4.2. Management of under-reporters

There are different options to tackle the problem of under-reporters. One may exclude the individuals with EI/BMR_{est} under a certain cut off point. This technique was used in the survey conducted in France (Afssa, 2009). The main drawback of such an option is that one may exclude some valid subjects who effectively ingested low quantities of food during the survey. BMR_{est} is based on observed body weight and may overestimate the true BMR in obese individuals leading to their undue exclusion. True under-reporters with high activity levels cannot be identified with this technique and would therefore be present in the final sample. As a consequence, the exclusion of potential under-reporters may create a biased sample.

Some authors propose a post hoc treatment of data to correct for under-reporting. Thus, Voss *et al.* (1998) assessed energy adjusted intake values according to the residual method, i.e. by using the residuals obtained by regressing absolute nutrient intake on total energy intake. In fact, the residuals are independent of the methodological influence of under-reporting. However, these kinds of techniques are useful in diet-disease risk analysis but do not have an application in the assessment of dietary exposure as there is a need to assess absolute food consumption.

Estimates of the distribution of usual energy intakes may also be adjusted with the use of biomarker data (doubly labelled water) from an external study (Yanetz *et al.*, 2008), but since under-reporting is

[10]http://www.idefics.eu

not homogeneous among food categories, this kind of technique also has no direct application to the assessment of dietary exposure.

A post hoc analysis of the observed food consumption data may be performed in order to assess uncertainty related to potential under-reporting. Thus, the quality of the survey can be assessed through comparison of the mean EI/BMR_{est} with Goldberg cut off points at the group level. This technique was used in the North South Ireland food Consumption survey (McGowan *et al.*, 2001), after exclusion of dieters and those who declared health problems. It was also used in the INRAN-SCAI 2005-06 survey conducted in Italy (Leclercq *et al.*, 2009), after exclusion of dieters and of any subject with self reported unusual consumption.

During such analyses, it is useful to identify foods that are more susceptible to under-reporting in order to evaluate the uncertainty in the assessment of dietary exposure. This is particularly important when these foods are the main contributors to the exposure of the chemical under investigation.

A validation study may be performed on a sub sample of subjects, to assess energy expenditure at group level.

Thus, position-and-movement monitoring can be used to estimate energy expenditure and is applicable to children (Lillegaard & Andersen, 2005). Other tools that can be used are accelerometers and heart rate monitors (Livingstone *et al.*, 2003). Similarly a validation study can be performed with biomarkers such as Double Labelled Water.

6.5. Conclusions for non dietary information and quality control

In order to ensure a low percentage of misreporting, the EGFCD recommends the observation of the survey protocol so that interviewers are in close contact with the subjects and that all self-recorded information is carefully checked during the interview. The survey duration must be as short as possible in order to keep up the subjects' motivation.

The EGFCD also suggests that individual subjects should not be deleted based on presumed under- or over-reporting assessed with a short-term survey. Only subjects considered unreliable by the interviewer should be excluded from the food consumption database. A post hoc analysis of observed food consumption data has to be performed in order to assess uncertainty related to potential under-reporting.

In children under 10 years of age the mean ratio of Estimated Energy Intake to predicted Energy Expenditure must be assessed at population level. To this aim, predicted energy expenditure will be calculated in each subject, based on the equations that allow to estimate energy requirement according to age, sex, body weight and height. Such equations have been developed by the Scientific Committee on Food (Commission for the European Communities, 1993) and may be revised in the future by the NDA Panel of EFSA.

In subjects up to 10 years and over, a questionnaire on physical activity could be used to assess PAL at group level (as described in section 6.4). EI/BMR_{est} will then be assessed at group level and compared with Goldberg's cut off points, (1991) as modified by Black (2000a, b), to take into account between and within subject variability in PAL. The mean EI/BMR_{est} provides an indication of the overall quality of the survey in order to characterise uncertainty in the food consumption data. Cut-off values should be specific for the mean estimated PAL in each population group.

In want of a previously validated questionnaire responding to the above enumerated needs, the EGFCD propose to use literature data on suitable PAL values for various population groups. However, the latter solution would still not be ideal since knowledge from small-scale studies in one population group does not necessarily transfer to another one with the same age and gender but from a different geographical area.

CONCLUSIONS AND RECOMMENDATIONS

The EGFCD stresses the importance of collecting accurate and harmonised food consumption data at the European level. In general, it is important that foods consumed are described in detail and that composite food and recipes are, as much as possible, disaggregated into their main ingredients. Based on the different biological agents and chemical substances under evaluation by EFSA from time to time, various kind of information describing the food consumed must be collected. The EGFCD in particular recommends the collection of information on brand name, physical characteristics of the packaging, cooking procedures and other specific information, such as fortification, animal origin, etc. Detailed information on the use of nutritional supplements by respondents should also be collected.

The EGFCD suggests that each national dietary survey is conducted in two phases. The first dietary survey phase includes children divided according to three age classes: infants, toddlers and other children. The second dietary survey phase includes all other subjects, with the exception of the very old (above 75 years of age), divided according three age classes: adolescents, adults and elderly. Pregnant women should be over-sampled and included in the same phase as the adults. The EGFCD recommends that the two proposed dietary survey phases be conducted in each EU Member State. In case of limited resources, priority should be given to children. A minimum of 2,000 subjects must be included in each country, by means of a random multistage sampling procedure. This means that at least 1,000 subjects have to be included in each of the two dietary survey phases recommended by the EGFCD. A larger number of subjects is strongly recommended for the most populated EU Member States.

The dietary survey phase including infants and children should be conducted using the dietary record method for two non-consecutive days and, if possible, using EPIC-SOFT as a data entry system.

In the case of adults, the EGFCD concludes that both dietary record and 24-hour recall methods are adequate to collect food consumption data. They are suitable for the risk assessment work conducted by EFSA, each method having its specific pros and cons. However, it is important that the same method is applied in each country within a pan-European dietary survey framework.

The EGFCD therefore recommends that the 24-hour recall method including two non-consecutive days is applied to the adult population. The first interview has to be carried out face-to-face, but other interviews can be administered via telephone in order to reduce costs per subject. This is considered the most cost/effective method and the main argument in favour of this choice is that the 24-hour recall can be better implemented, within a pan-European dietary survey, in order to increase the number of subjects and the participation rate.

Expenditure in terms of resources and time for the development or adaptation of new tools and procedures will be reduced in the event that EFSA can enter a long term agreement for the use of the EPIC-SOFT program, specifically developed for the 24-hour recall method. The use of this program will also facilitate the standardisation of data collection and data input and the control of the sources of error across countries.

Field workers should preferably meet with the participants in their homes. The EGFCD prefers nutritionists and dieticians to conduct the dietary interviews.

The EGFCD recommends the use of a validated picture book, adapted to country specific food items, to estimate portion sizes. Furthermore, it should contain pictures of household measurement tools and standard units. When children are the target population age, specific portion sizes should be included in the picture book. Manufacturer's information should be used when available.

The collection of non-dietary information should be reduced to a minimum. The EGFCD proposes to measure body weight and height and to use a questionnaire to assess PAL.

In order to reduce under-reporting as much as possible, the EGFCD recommends that the survey protocol be designed to allow direct contact between the interviewers are in close contact with the subjects and that all reported information is carefully checked during the interview. A post hoc analysis of observed food consumption data should be performed in order to assess uncertainty related to potential under-reporting.

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ABBREVIATIONS

AHAW	Animal health and welfare
ANS	Food additives and nutrient sources added to food
BIOHAZ	Panel for biological hazards
BMI	Body Mass Index
CEF	Panel for food contact materials, enzymes, flavourings and processing aids
Concise Database	Concise European food consumption database
CONTAM	Panel for contaminants in the food chain
CSFII	Continuing Survey of Food Intakes by Individuals
DAFNE	Data Food Networking
DATEX	Data Collection and Exposure Unit
EFCOSUM	European Food Consumption Survey Methods
EFCOVAL	European Food Consumption Validation
EFSA	European Food Safety Authority
EGFCD	Expert group on food consumption data
EI/BMR	Energy Intake/estimated Basal Metabolic Rate
EPIC	European Prospective Investigation into Cancer and Nutrition
EXPOCHI	Individual food consumption data and exposure assessment studies for children
FEEDAP	Panel for additives and products or substances used in animal feed
FEHES	Feasibility of a European Health Examination Survey
FFQ	Food Frequency Questionnaire
FIAS	Food Information Analysis
GMO	Genetically Modified Organisms
HBS	Household budget surveys
HRM	Heart Rate Monitoring
IARC	International Agency for Research on Cancer
MS	Member States
NCI	National Cancer Institute
NDA	Panel for dietetic products, nutrition and allergies
NDNS	National Diet and Nutrition Survey
NHANES	National Health and Nutrition Examination Survey
PAL	Physical Activity Level
PLH	Panel for plant health
PPR	Panel for plant protection products and their residues
PRAPeR	Pesticide Risk Assessment Peer Review
PSMAs	Portion Size Measurement Aids
RACs	Raw Agricultural Commodities
WG	Working Group
WHO	World Health Organization