TNO report
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European Food Consumption Survey Method

Final report

TNO Nutrition and Food Research

Utrechtseweg 48
P.O. Box 360
3700 AJ Zeist
The Netherlands

Phone +31 30 694 41 44
Fax +31 30 695 72 24

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Author(s)
EFCOSUM group

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EXECUTIVE SUMMARY

Introduction

The project 'European Food Consumption Survey Method (EFCOSUM)' was undertaken within the framework of the EU Programme on Health Monitoring. The purpose of this EU programme is to contribute to the establishment of a Community health monitoring system which allows for measurement of health status, trends and determinants throughout the Community, facilitating, planning, monitoring and evaluation of Community programmes and actions, and providing Member States with appropriate health information to make comparisons and support their national health policies. The aim of EFCOSUM was to define a method for monitoring food consumption in nationally representative samples of all age-sex categories in Europe in a comparable way. Additionally, the project aimed to indicate how to make existing food consumption data comparable and available to the health monitoring system (HIEMS).

A total of 23 European countries participated in this project (including all current EU members except for Luxembourg). Activities of the project included plenary sessions, desk research and working group activities, building on existing experience from projects such as DAFNE (Data Food Networking), EPIC (European Prospective Investigation into Cancer and Nutrition) and COST 99 Eurofoods Research action on food consumption and composition data (COST 99). Four working groups were established on the following topics:

1. comparability of food consumption assessment;
2. comparability of food composition tables;
3. software and statistics;
4. operationalization of a European food consumption survey.

During the course of the project it became clear that two additional expert meetings were needed: a) on food classification issues and b) on statistical modelling techniques.
The results of the working groups and the expert meetings were discussed in the plenary meetings and constitute the core papers and chapters of this report.

Harmonization of food consumption data

Currently, only food availability data from household budget surveys are comparable at the European level (DAFNE). It was the general opinion of the EFCOSUM group that there is a need for harmonizing consumption data at the individual level as well. EPIC developed methods to collect comparable individual dietary data specially focused on cancer and on adults.
Therefore, within the framework of EFCOSUM it was discussed first to what level existing data, available at the national level, could be made comparable at a European level (so-called post-harmonization). Second, it was discussed what actions are needed to arrive at food consumption data that are comparable among countries in the future ('pre-harmonization').

Post-harmonization of available food consumption data

In the EFCOSUM project careful consideration was given to available nation-wide food consumption surveys with nutrient intake data on the

individual level. There was general consensus that there is still a regrettable lack of internationally comparable data. Several pragmatic guidelines were developed which permit to select more comparable data in a transparent way. However, the consequence of using these guidelines is that about 15 countries can provide food consumption data that can be made reasonably comparable. It should be realized that these data are not yet available, that a lot of work has to be done, as explained below, and that comparability is limited.

With respect to food classification systems, it was recognized that all available classification systems and food composition databases are developed to be used for specific purposes at the national level. Therefore, EFCOSUM recommends starting to regroup available food consumption data according to the European Food Group system established in the context of COST Action 99. In this way food intake data can be made comparable at the 'raw edible' ingredient level. Furthermore, EFCOSUM recommends to start with four food groups considered to be the most important food groups for health monitoring purposes, namely 1) vegetables (potatoes excluded), 2) fruits (fruit juices excluded), 3) bread, and 4) fish (shellfish included).

Thus far, full comparability at the nutrient level is not possible. The EFCOSUM group concluded that for available food consumption data post-harmonization is only possible at the food level.

It is stressed that this action is a first step to arrive at harmonization of existing data of 15 countries. It is anticipated to be only sufficiently precise for crude estimates at the community level.

Pre-harmonization of food consumption data to be collected in the future

With respect to pre-harmonization of food consumption, i.e. data to be collected for the future, the following issues were discussed:

- Selection of relevant dietary indicators
- Selection of methods of food intake assessment
- Selection of food classification system
- Selection of food composition databases
- Biomarkers
- Statistical procedures
- Software
- Operationalization of a pan-European survey

Dietary indicators

The following dietary indicators were selected on the basis of their relevance to health, and also by their practicality for obtaining reliable and comparable data in Europe. As a consequence, the list is not intended to be complete from a scientific point of view. Therefore, this list of indicators should be regarded as a very minimum set.

- Foods: vegetables, fruits, bread, fish
- Nutrients: saturated fatty acids (% of total energy, E%), total fat (total lipids; E%), Ethanol (g/day)
- Biomarkers: folate, vitamin D, iron, iodine, sodium.

Energy intake has to be assessed in order to calculate E% for total fat and saturated fatty acids.

Methods of food intake assessment
The aim of the EFCOSUM project focuses on estimates of both acute and usual consumption levels. The method should allow a reliable comparison of large population groups' nutrition, should concentrate on general features of food consumption and nutrient intakes and should be collected at an individual level. A 24-hour recall method was selected as the best and most cost-effective method (e.g. applicable in large European populations of different ethnicity; relatively low respondent and interviewer burden; open-ended; suitable to assess average consumption in population groups). To obtain population distribution of usual intake, correction for within-subject variation is needed. To this end 24-hour recalls could be repeated.
For the estimation of infrequently consumed foods, it is recommended to add some questions on habitual consumption of these foods to get insight into the proportion of (non-)consumers.
Regarding the intake of contaminants and additives, other dietary intake measurements, such as duplicate diets, market basket studies and the use of EAN codes, are more suitable.
For those countries that wish to continue ongoing nutrition surveillance programmes using other methods for consumption measurements, the 24-hour recall should be used as calibration method.

Food classification system
A food classification system is needed to make food consumption data comparable at the food level. It was generally agreed that foods can only be made comparable at the 'raw edible' ingredient level. It is recommended to use the European Food Grouping system as a minimum level of comparability. Software should enable the conversion of foods as consumed (collected with a 24-hour recall) to foods at the 'raw edible' ingredient level.
Looking at the food groups that are considered of primary interest, the 'raw edible' level is required at least for vegetables (excluding potatoes), fruits (excluding fruit juice), bread, and fish (including shellfish).

Food composition databases
Within the EPIC context it was already concluded that national food composition tables and databases are not sufficiently standardized to be used for comparison of intake data at the nutrient level. As a consequence, a start has been made with the compilation of a European Nutrient Database (ENDB) in which macronutrients as well as some micronutrients will be included. This work is expected to be finished in 2002.
The EFCOSUM group recommends the usage of this ENDB as a starting point for making intake data comparable among countries at the nutrient level.

Biomarkers
Of the selected dietary indicators folate, vitamin D, iron, iodine and sodium were considered hard to assess in the diet in a comparable way among countries; thus, for these micronutrients biomarkers were recommended. The actual use of biomarkers introduces a considerable extra burden in dietary surveys in terms of logistics, budget and practical consequences. Therefore, EFCOSUM recommends to include the collection of these biomarkers in other pan-European health examination surveys.

Statistical procedures

Within the framework of harmonization statistical aspects play an important role. An appropriate sample size, data analysis and data presentation are crucial to the final outcome of a survey, particularly in comparisons between countries, i.e. sample size, number of repetitions and presentation of data.

The EFCOSUM project has calculated that the sample size in each country should be at least 1,000 persons for proper data on fat (lipid) intake, whereas at least 2,000 subjects are needed for fruit and vegetable consumption figures with a desired precision of 5%. This means a starting point of at least 2,000 persons per country.

The number of repetitions needed to correctly identify an individual's intake depends on several factors. It was agreed that for health monitoring purposes at least two non-consecutive 24-hour recalls are needed assuming that enough persons are included in the survey.

To get insight into the usual intake distribution this 2-day recall method can be repeated several times during a certain period. However, it is also possible to use modelling techniques for estimating the usual intake distribution based on short-term measurement. EFCOSUM proposes to use modelling techniques, i.e. the simplified transformation procedure of Nusser et al. (1996).

For presentation of the data, parameters of interest are mean, median, quartiles, P5 and P95.

The 24-hour recall can be used for children over 10 years of age and EFCOSUM therefore recommends to concentrate data collection on the age group of 11 years and older. For comparison with recommendations, for example, the age-sex group classification used in the Scientific Committee for Food is advised: 11-14 years, 15-17 years and 18 years and older. However, there may be particular problems in individual countries with respect to recruitment, interview setting and logistical aspects of operationalization that necessitates excluding ages below 15 years.

Software

The use of strictly standardized procedures is needed in order to prevent or minimize systematic and random measurement errors among countries.

The EPIC-SOFT program has been developed to collect interactive dietary interviews comparably among countries. It is recommended to use EPIC-SOFT as the first choice to collect 24-hour recalls in all European countries. However, additional developments and improvements are needed to adapt the software for the aims of EFCOSUM and make it independent of EPIC logistics. If EPIC-SOFT is not the option, other computer software and/or 'manual methods' can be used to collect 24-hour recalls using the rules and procedures of EPIC-SOFT as far as possible.

For the quantification of portion sizes the use of a picture book is recommended. The ideal situation would be to use a picture book with the main part being equal for all countries and supplemented with country-specific pictures for national dishes and/or deviant common portion sizes.

Operationalization of a pan-European food consumption survey

With the emergence of multi-centre collaborative epidemiological research and health monitoring programmes it has become increasingly clear that the issue of standardization of methods, measurements and fieldwork is of crucial importance.

Issues such as sampling procedures, recruitment, fieldwork, use of biomarkers, interviewer qualification and training, and quality control are addressed in detail in this chapter of the report.

Overall conclusion

The findings of EFCOSUM emphasize the need for co-ordinating nutritional surveillance activities within the European Union. The project revealed again that the diversity of approaches to assess dietary intake on an individual level is huge. As a consequence, available data sets on dietary intake at the country level are not directly comparable. As a first step in harmonization, existing data of 15 countries can be made comparable at the food level. These data are not available yet, and much is still to be done.

The data from household budget surveys of 13 European countries (DAFNE project) can fulfil the needs of HIEMS at the food availability level. However, to study the relationship of diet and health and for a proper identification of risk groups, data at the individual level are recommended.

The EFCOSUM project demonstrated that there is a broad European consensus on the basic ingredients of an individually based monitoring system oriented at diet. The consortium of 23 countries has created not only the general outline regarding methods, indicators, etc., but also the proof that it is feasible to carry out a European survey. Therefore, the proposal can be implemented when the necessary funds are made available. This would be the first option in the perspective of the aims of HIEMS. In the meantime, it is recommended that any country that will carry out a (national) food consumption survey includes the minimum amount of 24-hour recalls that allows a calibration with other countries.

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List of Abbreviations

CALEUR	Calcium Intake and Peak Bone Mass: A European Multicentre Study
CIAA	Confédération des Industries Agro-Alimentaires
COST Action 99	Cooperation in Science and Technology
CVD	Cardiovascular Disease
DAFNE	Data Food Networking
EAN	European Article Numbering
ECHI	European Community Health Indicators
EFCOSUM	European Food Consumption Survey Method
EFG	Euro Food Group
ENDB	European Nutrient Database
EPIC	European Prospective Investigation into Cancer and Nutrition
EUPASS	European Physical Activity Surveillance System
EUPHIN	European Union Health Information Network
EURALIM	Europe Alimentation
EUROFIR	European Food Information Resource
EURONUT	European community concerted action on Nutrition and Health
EUROSTAT	European Statistics
FAO	Food and Agriculture Organization
FBS	Food Balance Sheets
FFQ	Food Frequency Questionnaire
FLAIR	Food-Linked Agro-Industrial Research
GEMS	Global Environmental Monitoring System
HBS	Household Budget Surveys
HIEMS	Health Information and Exchange System of Member States
IARC	International Agency for Research on Cancer
INFOODS	International Food Data Systems
MONICA	Multinational Monitoring of Trends and Determinants in Cardiovascular Diseases
NORFOODS	Nordic Cooperation of Food Composition Data
PROCOME	Eurostat Food Coding System
SENECA	Survey in Europe on Nutrition and the Elderly a Concerted Action
TRANSFAIR	Trans Fatty Acids in Foods in Europe
WHO	World Health Organization

1. RATIONALE AND METHODS OF THE EFCOSUM PROJECT

1.1 EU Programme on Health Monitoring

The activities of the European Union in the field of public health need to be underpinned by high quality information which has been analysed effectively and presented in appropriate ways to those who make or influence decisions. Health monitoring is an essential part of the policy cycle leading from policy formulation through planning to implementation and evaluation. European Union health monitoring information will also help Member States carry out their own public health responsibilities by providing comparative information.

In the present situation Member States are collecting data and information for national purpose level, which are often of limited comparability and of varying quality. Besides, there is limited co-ordination of the data collection and there are still important gaps in the data available on a number of important diseases and determinants of diseases.

The prime reason for having the action programme on health monitoring is the development and exchange of adequate, reliable and comparable indicators of public health, and the structures needed to exchange the relevant data. The programme should work through making use of the expertise built up in the Member States and act as a co-ordinating force between them.

The objective of the action programme is to contribute to the establishment of a Community Health Monitoring System, which makes it possible to:

- measure health status, trends and determinants throughout the Community;
- facilitate the planning, monitoring and evaluation of Community programmes and action;
- provide Member States with appropriate health information to make comparisons and support their national health policies.

1.2 European Health Monitoring System

The structure of the Health Monitoring System (see annex B-8, paper Kearney)
The improvement of information exchange is a key element for the future development of public health in the community.
The Community's role in public health has to evolve to deal with new challenges, changed circumstances and the greater role envisaged for public health in the Amsterdam Treaty. Drawing from these factors and the experience of the existing framework, the future public health policy as mentioned in the paving communication COM(98)230 of 15.04.98 should comprise three strands of action:

- improving information for the development of public health;
- reacting rapidly to threats to health;
- tackling health determinants through health promotion and disease prevention.

These three strands would also enable the Community to respond effectively to the challenges of enlargement, and to the issues of health requirements in other policies. Therefore, the implementation of the EUPHIN network (European Union Health Information Network) will play a major role in the achievement of results for these strands as it is intended to fulfil the need for rapid and reliable exchange of health information for European countries.

The objective is to establish the telematic network EUPHIN which will be a structured and comprehensive Community system for sharing, exchanging and disseminating information within the public health.
The EUPHIN network is clearly mentioned in the public health programmes. It involves many competent authorities and a number of health issues are going to be supported by this network. The difference in sensitivity of the information to be exchanged and shared within the systems of EUPHIN also plays an important role in the technical description of the network and the project organization. All these aspects increase the complexity of the project.

The EUPHIN telematic network has been put in place to support several databases, such as the HIEMS database (Health Information and Exchange System of Member States). The HIEMS application is a Community-wide database for sharing health data and is developed for the Health Monitoring Programme. Besides HIEMS, the following databases can be identified within the EUPHIN network, which are at different levels of maturity:

- a health surveillance application for communicable diseases (EUPHIN-HSSCD)
- a blood transfusion chain application (EUPHIN-BLOOD)
- an injury data application (EUPHIN-INJURY) integrating, in particular the home and
- leisure accidents database (EHLASS).

  All these databases are used for direct access to answer questions related to health issues coming up from the European community. The EUPHIN network consists of a single centralised system that is currently operating by Cap Gemini in Belgium, and databases have to be delivered to them.

Datafusion
Datafusion is meant to enable the linking of different databases, using key entries, which are present in all the different databases and defined in the same way. After proper linking of these databases additional/secondary analyses can be made. This in order to give answers to questions which are not possible by simply looking to individual datasets who give insight in part of the expected problem. But by combining related health outcomes, present in more databases, a more complete picture of the situation can be given.

In the HIEMS database, Community health indicators need to be established. The ECHI project (European Community Health Indicators) has been carried out to indicate what health indicators are included in the Health Monitoring Program and what indicators are still missing but are considered to be relevant to include in the future. The set of indicators described in the ECHI project can serve as starting point for proper identification of variables which have to be measured to ensure the possibility of datafusion with other health monitoring studies. For instance, there is a close connection between physical activity and diet (see also annex B-7, paper Johansson). In the context of HIEMS data of the project European Physical Activity

Surveillance System (EUPASS) and the EFCOSUM project might give opportunities for datafusion.

1.3 European Food Consumption Survey Method (EFCOSUM*)*

Background
Of the many determinants of health, diet is one which can be improved by appropriate intervention measures. To assess the need for intervention and to evaluate the effect of measures taken, the monitoring of diet over prolonged periods of time is essential. In the field of nutrition, however, there is a regrettable lack of internationally comparable data. In the final report of SCOOP Task 7.1.1 (1997) in which 14 European States participated, it is concluded that detailed evaluation of dietary intake in Europe is not possible, despite the fact that dietary intake data were available for most of the participating Member States. At present there are several European initiatives to improve the comparability of national food consumption data, such as the DAFNE project (DAta Food NEtworking) and the EPIC study (European Prospective Investigation into Cancer and Nutrition). Each of these projects is carried out in a different subset of Member States, in different population samples and has different aims. The progress produced in each of these projects could form the starting point for a truly European food consumption surveillance, delivering internationally comparable data on individual consumption on a regular basis. Other projects currently in progress or in preparation within the EC monitor other indicators/determinants of health status, life style and health habits as well as indicators related to living and working conditions. Therefore, it is important that the data set of a European food consumption survey is compatible with the data sets of other relevant monitoring studies.

Aims
The European Food Consumption Survey Method (EFCOSUM) aims to define a (minimum) set of dietary components which are relevant determinants of health and to define a method for the monitoring of food consumption in nationally representative samples of all age-sex categories in Europe in a comparable way (pre-harmonization). This method will be used alone, or as a calibration method for ongoing studies. The project will make use of the progress in relevant projects carried out until now and will ensure the possibility for datafusion with other health monitoring studies. With this method in the future it must be possible to estimate average intake and distribution among individuals of energy, macro- and micronutrients, estimate high intake levels of contaminants and additives among individuals, estimate the consumption of specific foods, and compare data from different countries (pre-harmonization). Furthermore, the project aims to indicate how to make existing food intake data comparable and available to the Health Monitoring System (post-harmonization).

Deliverables
The project will provide guidelines for making available data more comparable for a minimum set of dietary health indicators and will provide a proposal for collecting dietary intake data for monitoring purposes on a national level, with a method that provides internationally comparable results (including calibration of existing methodology). Recommendations

will be given on the operationalization of a European food consumption surveillance, software tools and uniform presentation and analysis of the data.

1.4 Methods

The project has been carried out by 14 Member States as well as 9 other European countries. A list of participants is presented in annex A. Activities of the project included plenary sessions, desk research, and working group activities, building on existing experience from such projects as DAFNE, EPIC, FLAIR Eurofoods-Enfant project, COST Action 99 and others. Representatives from all participating states took part in one or more working group activities, which were finally worked out in plenary sessions. The results of the working groups contributed to the preparation of a final report.

Working groups

Four working groups were established on the following topics:
1. comparability of food intake assessment;
2. comparability of food composition tables;
3. software and statistics;
4. operationalization of a European food consumption surveillance.

Each working group included a reporter and a chairperson. The reporter was provided by TNO and the chairperson was chosen by the working group.
The four working groups mentioned above are successively dealt with in the sections to follow.

1. Comparability of food intake assessment
The aim of working group 1 was to select a cost-effective method for the monitoring of food consumption in Europe, delivering internationally comparable data on individual consumption on a regular basis. This method of food intake assessment should be used alone or as calibration method for ongoing studies. The working group made use of the inventory from the co-ordinating centre of existing progress in the field of comparability of food intake data.
The primary question was:

> Which method of food intake assessment is most appropriate to collect comparable food intake data from different countries to use alone or as calibration method?

Derived questions were:

> Which criteria will be used?
> How should the portion size be assessed?

Which dietary components belong to the minimum set of health indicators?
How can existing food consumption data in Europe be harmonized (post harmonization)?

> Is there a unified food classification system in the different countries? If not, how can we proceed to the harmonization of a comparable food grouping system?

The latter question was dealt with working group 2 that took the lead for this topic.

2. Comparability of food composition tables

The aim of working group 2 was to provide reliable and comparable data on the content of dietary components of foods in Europe. The group made use of the inventory on comparability of food composition databases/tables of Deharveng et al. (1999) carried out in the EPIC context.

The primary question was:

Are the food composition tables used in the different countries comparable? If not, how can we improve the comparability?

Derived questions were:

Which nutrients are included in the tables?

. Which databanks in the EU exist on nutrients not included in the national food composition tables, such as TRANSFAIR (trans fatty acids)?

What is the quality of the nutrient values from the point of view of chemical analytical methods?

How can we improve the comparability of definitions and mode of expression for nutrients?

How are we dealing with the absence of national food composition tables? How are we dealing with compiled tables?

During the course of the project it became clear that the comparability of food classification systems was an issue of utmost importance and therefore this topic was taken into account too.

3. Software and statistics

The aim of working group 3 was to evaluate the existing data collection software and to work out statistical aspects, such as sample size, measurement of time trends and uniform analysis of the data. A distinction was made between the food consumption method which is used alone and which is used as calibration method.

Main tasks were:

To make an inventory of the existing data collection software and to evaluate the European Monitoring System;

To work out statistical aspects for national monitoring and international calibration purposes.

Derived questions were:

What changes are suggested to adapt the existing data collection software for use by all participants?

What software specifications are proposed to make the food intake data set compatible with the European Monitoring System?

Which variables have to be measured to ensure the possibility of datafusion with other health monitoring studies?

What is the appropriate sample size taking into account the number of measurements?

How do we measure time trends?

4. Operationalization European food consumption surveillance

The aim of working group 4 was to work out logistics in order to conduct a European food consumption surveillance using the experience of DAFNE, EPIC and other large European nutritional surveys in which food consumption data were gathered at an individual level.

The tasks of the working group involved:

development of uniform sampling, recruitment and fieldwork procedures;

development of quality control system;

protocols for the training of personnel.

Outline of the report

This report deals with the different issues as mentioned above. Most chapters are based on one or more original papers, written by EFCOSUM participants. These papers are presented in annex B (alphabetical order of first author). In the project, decisions had to be taken on two levels, first, on the comparability of existing data and second on the collection of comparable new data. To facilitate these choices, decision trees were used (see annex C). An overview of existing food consumption surveys, results of inventories of operationalization and the original questionnaires on the comparability of foods, sample size estimations and operationalization are included in annex D, E and F, respectively.

In chapter 2 the selection of relevant dietary indicators is presented. In chapter 3 the comparability of existing data is discussed and recommendations for post harmonization are given, using among others the decision tree presented in figure 1 (annex C). Chapter 4 deals with methodology of food intake assessment. For the selection of the most appropriate dietary method to collect new comparable food intake data several decisions had to be made which are inter-linked at different levels. In figure 2 this is represented schematically (annex C). In chapter 5 recommendations for a food grouping system and food composition tables are presented. Statistical aspects are discussed in chapter 6 and in chapter 7 data collection software is addressed. Aspects on the operationalization of a European Food Consumption Surveillance are discussed in chapter 8. After a general discussion in chapter 9 overall conclusions are presented, ending up in a protocol with recommendations, as a first step to concretise a pan-European food consumption survey.

References

- Deharveng G, Charrondiere UR, Slimani N, Southgate DAT, Riboli E. Comparisons of nutrients in the food composition tables available in the nine European countries participating EPIC. Eur J Clin Nutr 1999; 53: 60-79.

2. SELECTION OF RELEVANT DIETARY INDICATORS

(see annex B, paper Steingrímsdóttir (B-13) and paper Ovesen (B-10))

One of the aims of the European Food Consumption Survey Method (EFCOSUM) is to define a set of dietary components which are relevant determinants of health in Europe. These dietary components are intended to serve as nutrition indicators in the European Health Monitoring Program and as such should be limited in number, relevant for health and practical for all involved countries with respect to data gathering and comparability of data.

Epidemiological and clinical research in the field of nutrition has identified several important dietary factors relevant for the development of chronic diseases. For many major factors there is general consensus among scientists with respect to their role in disease aetiology. This consensus is reflected in international reports and nutrition action plans, where major nutritional factors relevant for health in Europe are defined. These include a report on Health and Nutrition prepared by the French Presidency of the European Union (French Presidency, 2000), which refers to the report from the project Nutrition and Diet for Healthy Lifestyles in Europe (EURODIET; 2000) and reports from The World Health Organization, Regional Office for Europe (WHO, 2000a and b).

Diet and health

Cardiovascular disease (CVD) is the main cause of death in the European Union and it is estimated that more than a third of cardiovascular deaths of people under the age of 65 are attributable to diet (Rayner & Peterson, 2000; Ferro-Luzzi & James, 1997). The most important dietary factors are those that affect serum cholesterol levels. Thus, diets high in saturated fatty acids but low in foods of plant origin, increase the risk of cardiovascular disease, while diets high in fruits and vegetables but low in saturated fat are protective. Also diets including a weekly fish meal are associated with lower cardiovascular risk (Deckere et al., 1998), while sodium rich diets contribute to hypertension and stroke (Sacks et al., 2001, Tuomilehto et al., 2001).

Cancer accounts for 29% of all deaths of men and 22% of women in the EU (French Presidency, 2000) and it is estimated that between 30 and 40% of these can be attributed to dietary factors (Doll & Peto, 1981). Excess energy and alcohol intake are risk factors for cancers of the mouth, pharynx, larynx, oesophagus and liver, while high intakes of fruits and vegetables are associated with reduced risk of cancers of mouth, pharynx, oesophagus, stomach and lung (WCRF/AICR, 1997). Other factors still need clarification, such as the relationship between dietary fatty acids and cancers, as well as the possible protective role of fruits and vegetables in cancers of the colon, breast and prostate.

Prevalence of obesity and overweight are rapidly increasing among all age groups in Europe, both children and adults alike. Consequently diseases resulting from excess body fat, not the least diabetes type 2, are expected to follow this development, and become an ever increasing burden on society and health care (WHO, 1998). Diabetes prevalence is already rapidly rising in Europe and it is estimated that at least 80% of diabetes type 2 are due to obesity and overweight. Lack of physical activity in daily life combined with

energy dense, high fat diets, contributes to increased weight gain and obesity in most societies.

Osteoporosis and the associated bone fractures among post-menopausal women and older men are predicted to become an increasing burden on society as a result of increasing age of European populations. Physical activity and sufficient calcium and vitamin D from childhood to old age are preventive factors against osteoporosis (EU Commission, 1997).

While the relative importance of nutritional deficiency diseases have diminished in European populations in recent decades, certain nutrient deficiencies are still of concern. This includes iron deficiency, which is prevalent among young children and women of child bearing age in most European countries. Iodine deficiency is also a health problem in many European countries involving 16% of the European region (Delange et al., 1993). Lack of both these micronutrients affects the health and well being of a large number of people. Iron deficiency anaemia is associated with impaired immune function and diminished learning capacity in children and decreased physical fitness and work capacity in adults (WHO, 1989). While severe iodine deficiency giving rise to mental retardation is eradicated in Europe, mild and moderate iodine deficiency is still prevalent in many European countries. Mild and moderate iodine deficiency increases the risk of goitre and hyperthyroidism, especially in the elderly (Laurberg et al., 2000). Iodized salt is an effective public health measure to introduce iodine in the general population but few European countries require universal iodination of salt. Folate is also a nutrient of special concern as a clear link has been established between folic acid intake of mothers and the occurrence of certain birth defects, especially neural tube defects (MRC, 1991). Biochemical indications of folate insufficiency are found in a large proportion of adults with evidence of increased risk of cardiovascular disease as well as birth defects. Green leafy vegetables are a particularly rich source of folate as well as some fruits and bread, whereas in some countries cereal products are enriched and therefore are an important source. Some European countries encourage all women of child bearing age to take folic acid supplements as a preventive measure against neural tube effects in their offspring.

Diet indicators for health monitoring in Europe

The choice of dietary indicators must be governed not only by their relevance for health but also by the practicality of obtaining reliable and comparable data in European countries. Such considerations limit for example the feasibility of selecting many nutrients mentioned above in spite of their importance for health. This includes intake data of vitamin D, folate, sodium, iron and iodine, all of which are of important health significance but are difficult to measure in the diet in a comparable way between countries. Information on vitamin D in food composition tables is often incomplete, folate values of foods are not comparable in European databanks due to different laboratory methods for determination, and use of iodized salt and iron fortified foods make intake estimates difficult for these nutrients. Finally, sodium intake is difficult to measure from food consumption data, as sodium content of otherwise similar foods varies greatly according to the amount of salt used in preparation and at the table.

However, all of these nutrients can be estimated with the use of biomarkers. It should therefore be considered to include biomarkers of these selected nutrients as dietary indicators instead of dietary intake data. Other important nutrients, while still posing problems and needing harmonization and standardization cross countries, lend themselves better for comparison using intake data. These include total energy, total dietary fat, saturated fatty acids and ethanol. While total energy is not a useful indicator by itself (body composition is preferred), energy intake is needed to calculate the contribution of saturated fatty acids as well as total fat to energy intake (total fat refers to total lipids). While dietary calcium has a role in the prevention of osteoporosis, priority is given to information on physical activity (will be included as an indicator in EUPASS project). Consequently calcium is not included in this minimum set of relevant variables.

Foods or food groups may in many instances be easier to compare between countries than nutrients. Some foods or food groups may even give more relevant health information than single nutrients. Fruits and vegetables are in this category, as more data are available concerning the importance of fruits and vegetables in the diet than for single constituents in these foods. As consensus is lacking on the beneficial effect of fruit juice on health, it was decided to exclude these beverages with the exception of freshly squeezed fruit juice. To be specific, nuts, seeds and olives are not included in the fruit group and pulses and potatoes are not included in the vegetable group. While several other food groups contain constituents with positive health aspects, such as vegetable oils, meat & meat products, dairy products etc, priority was given to fish (including shellfish) as well as bread, both being foods with great significance for health. Epidemiological studies have shown that populations that consume fish on the average once or twice per week have lower risk of cardiovascular disease and consumption of the basic food group bread is considered as an indication of the proportion of carbohydrate in the diet.

In order of priority, the following list of diet indicators is recommended for health monitoring in Europe. The selection is based on aspects from the report from the French Presidency as well as the arguments listed above.

1. Vegetables
1. Fruit
2. Bread
3. Fish
4. Saturated fatty acids, E%
5. Total fat, E%
6. Ethanol (g/day)

Biomarkers should be considered for the following nutrients:

8. Folate
9. Vitamin D
10. Iron
11. Iodine
12. Sodium

Energy has to be determined in order to calculate %E from total fat and saturated fatty acids.

Biomarkers

Some biomarkers of diet promise to provide accurate measure of dietary intake or nutrient status, and a more objective one. They are not reliant on the subject's memory or on the accuracy of recording food intake, neither are they dependent on the accuracy of food data tables. Ideally biomarkers should be specific and sensitive, and not too invasive for human studies. Biomarkers of diet can be categorised into two types (Kaaks et al., 1997):

1) those biomarkers which provide an absolute quantitative measure of dietary intake, e.g., 24-hour urinary sodium or iodine as a measure of the 24-hour intake, and
2) those biomarkers which measure the concentration of a given factor, e.g., nutrient concentration in blood or other tissue, but for which there is no time dimension to the measurement. Although these biomarkers correlate with intake, they provide no absolute measure of it. However, they are nevertheless useful in categorising individuals into relative levels of intake.

As mentioned above, biomarkers should be considered for the intakes of iodine, sodium, iron, folate and vitamin D.

Since the majority of dietary iodine, over 90%, is excreted in urine and only a minor fraction in faeces, urinary iodine is a widely used biochemical marker of iodine intake. Iodine in casual urine samples gives a reasonable estimate of iodine intake in a population. Accuracy is increased if adjustments are made for sex and age (Knudsen et al., 2000). Single 24-hour urinary iodine excretion has an even higher accuracy, however, repeated 24-hour urine is necessary for an accurate assessment of the habitual iodine intake and iodine status of the individual (Rasmussen et al., 1999).

Concerning sodium, more than 90% of dietary sodium is recovered in the urine with sodium output in sweat and faeces accounting to a few percent (in temperate climates). A single 24-hour urine collection from an individual is sufficient for an estimation of habitual sodium intake in a population. Accurate individual intake assessment requires multiple 24-hour urine collections (Liu et al., 1979; Schachter et al., 1980).

Serum ferritin is a sensitive test of iron status (mobilizable storage iron) in epidemiological surveys comprising healthy individuals and continues to be the leading single determination. Serum transferrin receptor is a promising alternative (Ahluwalia, 1998). It is more specific than ferritin and can be used, especially if elderly (inflammations) and pregnant subjects are included. Another common -and better- approach is to use various combinations of tests, e.g., hemoglobin, serum ferritin and serum transferrin receptor.

Decreased extracellular (serum) folate is the first indicator of negative folate balance, but does not provide information regarding body stores. Serum folate is very sensitive to recent intake, and therefore, may be less suitable to use as a marker of folate status in epidemiological studies (Stites et al.,

1997). For long term folate status erythrocyte folate is the method of choice. Homocysteine in blood can probably be used as an alternative method. Both methods are able to discriminate between normal status and levels of insufficiency in the single individual.

For assessment of the vitamin D nutritional status the concentration of 25-hydroxyvitamin D (25(OH)D) in serum is considered as an accurate, integrative measure reflecting an individual's dietary intake and endogenous (cutaneous) production (Parfitt, 1998). Serum 25(OH)D is a good marker for vitamin D deficiency in the individual, and can distinguish between overt deficiency and marginal deficiency, especially if combined with serum PTH (McKenna & Freaney, 1998). However, the level of 25(OH)D which defines hypovitaminos D is not known.

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3. COMPARABILITY OF EXISTING DATA

3.1 Inventory on comparability of intake data and food composition tables

3.1.1 Introduction

At present, there are several European initiatives to improve the comparability of national food consumption data, such as the DAFNE project on household budget surveys. Moreover, in cross-cultural studies of the relation between diet and disease, methods have been developed to collect comparable intake data in specific populations - the EPIC study is a good example. Each of these projects is carried out in a different subset of Member States, in different population samples and has different aims. The progress produced in each of these projects could form the starting point for this truly European food consumption surveillance, delivering internationally, comparable data on individual consumption on a regular basis. In the past, the Eurofoods-Enfant Concerted Action project and the follow-up Cost Action 99 have performed a lot of work on the identification of foods and established rules for the compilation of food composition tables in Europe.

In the following overview, a summary is given of national and international food consumption surveys conducted in Europe. Furthermore, the existing progress in the field of comparability of dietary intake data and food composition tables across countries is given, using the experience of DAFNE, EPIC and other relevant projects (COST Action 99, NORFOODS). Several steps in the collection of consumption data are discussed. First, the selection of methodology of food intake assessment is mentioned, and secondly, classification of food products and food composition issues are discussed.

3.1.2 National surveys

Most European countries have carried out national dietary surveys that provide valuable information for usage in national nutrition policy and nutritional surveillance. Annex D presents national dietary surveys on an individual level conducted in different European countries. In this table it is demonstrated that the year of conduct, the population groups, the age categories, and the dietary methods greatly differ between countries. Therefore, it is not possible to use these data for a detailed evaluation of dietary intake in Europe, yet. In spite of that, it seems important to find a way to improve the comparability of national food consumption databases in order to have a crude estimate of intake assessment at a community level. In addition, the results of such comparisons could be used as a calibration method or as a first preliminary step to a more accurate national estimate. In paragraph 3.2 this will be discussed further.

3.1.3 European surveys

In contrast to national surveys, European surveys can be used for comparisons of dietary intake data across countries, provided that the methods used to collect dietary intake data and food composition tables (if dietary intake of nutrients and other substances are calculated) across the countries are comparable. Several European studies on dietary intake have

been conducted, such as CALEUR, DAFNE, EPIC, SENECA and TRANSFAIR. These studies differ in quality of providing comparative dietary intake information across countries. CALEUR, EPIC and SENECA are examples of international projects that developed procedures to allow pre-harmonization of food consumption data. TRANSFAIR worked on the establishment of an international comparable analytical database on fatty acids in foods. DAFNE is an example of a European project that worked on procedures to allow for post-harmonization. EPIC and DAFNE are still very active in improving the possibilities for international comparisons of intake data.

DAFNE (Data Food Networking) has been successful in harmonizing at the international level dietary exposure from household budget surveys. The overall aim of DAFNE initiative is the formation of a European Food Data Bank based on household budget surveys (HBS). The tasks of DAFNE include study of current methods of HBS data collection and processing in the different countries, and to select parameters from the national HBS that would be of use to the DAFNE project such as general, nutritional and socio-economic information. Furthermore, the comparability and harmonization of sociodemographic data (education of household members and category of locality are parameters of interest) were examined. Finally, the harmonization of food data (issues of food codification and food aggregation are priorities) from various countries was examined and the comparability of food data has been achieved (Annex B-9) (Trichopoulou and Lagiou, 1997 and 1998).
In the context of the FAIR-97-3096 project of the European Commission entitled ‘Compatibility of household budget and individual nutrition surveys and disparities in food habits’, food availability at the individual level has been estimated after applying statistical modelling to household data (Trichopoulou and Naska, in press).

EPIC (European Prospective Investigation into Cancer and Nutrition) developed methods to collect comparable individual dietary intake data in specific populations. The rationale of the EPIC project is setting up a large European prospective cohort study combining epidemiological and laboratory methods in order to expand the presently limited knowledge of the role of nutrition and related factors in cancer etiology. The EPIC project was designed with the aim of minimizing the variance ratio of within-subject variations due to random measurement errors over the between-subject variations in true dietary intake levels by both reducing the numerator and increasing the denominator. This can be achieved by developing better dietary assessment methods and conducting studies in populations with very heterogeneous dietary habits. Therefore, on the one hand, country-specific dietary assessment methods capable of measuring habitual food intake at the individual level in as much detail as possible were developed and validated. On the other hand, a highly standardized dietary assessment method was designed for calibration of dietary measurements between EPIC centres (Riboli and Kaaks, 1997).

3.1.4 Comparability of food consumption data

The comparability of food consumption data depends on several parameters, such as

- methods used to collect dietary data,

- the food categorisation system

Their interpretation depends on the food composition table used.
The way of data collection is discussed in this paragraph and the food categorisation system and the food composition table in the next two paragraphs.

To collect dietary intake data on an individual level, several methods can be used. Briefly, the methods can be divided into two categories, record and recall methods. Record methods collect information on current intake, keeping a record of all foods and drinks based on menu, household measures and/or weighing, over one or more days. Recall methods reflect past consumption, varying from intake over the previous day (24-hour recall) to usual food intake over the previous months or years (dietary history or food frequency). Each form has its own possibilities and limitations and weaknesses, and there is no single ideal method. The methods for estimation of dietary intake of individuals, with strengths and weaknesses of each method are described in the paper of Hulshof and Brussaard (1997). For intercultural comparisons of mean dietary intake levels, a 24-hour recall method might be suitable, since they provide similar results. The EPIC-study selected the 24-hour recall method as reference method to validate food frequency questionnaires in each country. Moreover, they used this method as reference measurement in a between-country calibration study to correct for some systematic over- or underestimation of the average dietary intake in some of the countries (Kaaks and Riboli, 1997).

3.1.5 Comparability of food classification/identification systems

Ireland and Møller describe different systems of food identification (Ireland and Møller, 2000).
In general two types of systems are given: i.e. a classification system and a descriptor system. A classification system tends to group or aggregate foods with similar characteristics: it is a tool of the ‘end’ user of data. Examples of these types of systems are the national food grouping systems based on the national food codes and the different systems used on a European level: CIAA Food categorisation system, the FAO/WHO Codex Classification of Foods and Animal Feeds, Food Balance sheets, EU Combined Nomenclature, PROCOME, PROCOME-Eurostat, DAFNE and the Eurocode 2 system.
Based on the general need for a common classification for comparative purposes, the EFG (EuroFoodGroup) system was developed in the COST Action 99 in an attempt to evaluate the level of food description and classification that would permit international comparisons. It is the ‘least common denominator’ at raw food (ingredient) level of the following international and national projects:
(1) International: the DAFNE classification system for Household Budget Survey (HBS) data as basis: supplied information from the WHO GEMS regional diets, the FAO Food Balance Sheet, and the Eurocode 2 core classification;
(2) National: The Dutch National Food Consumption Survey (1998), the British National Food Survey and the French National Food Consumption Survey (1999).

A descriptor system is a tool of the data originator, who wants to give a description of the food, as precise as possible, without the necessity of

aggregating them. The LanguaL thesaurus is an example of such a system. A user interface has been developed that allows to search foods available in the American, Danish, French and Hungarian databases. The European LanguaL Technical Committee is currently addressing issues regarding further clarification of facets and introducing other terms or specific food groups.

In multi-centre studies, the level of detail on the recorded food data varies from one country to another. Furthermore, food groups appear to overlap among countries. Since the data do not share the same degree of detail, aggregation of the food items to the lowest level of information is necessary. Therefore, food aggregation tables were developed in the DAFNE-project, which provide comparable categories of food items among participating countries (Trichopoulou and Lagiou, 1997 and 1998).

EPIC developed a computerised 24-hour diet recall interview program (EPIC-SOFT), which was adapted for each participating country, to provide comparable food consumption data between several European countries. Common rules were pre-entered into the system to describe, quantify and check automatically ~1500-2200 foods and 150-350 recipes of the different EPIC-SOFT versions. In addition, the dietary data collected with national versions of EPIC-SOFT were pre-coded and classified according to a common classification system (Slimani et al., 1999).

3.1.6 Comparability of food composition data

Food composition databases are used for the conversion of foods into nutrients. Many European countries have compiled their own national food composition database. The use of national food composition databases has many advantages. Firstly, they contain the most popular foods consumed in the given country. Secondly, their nutrient content meet the characteristics of foods locally produced; the nutrient content depends on the species of plants and animals, on cultural technology, on climatic conditions, on processing and storing circumstances and they vary in different countries. Finally, the naming of food and in the case of cooked dishes the raw material used for preparing the meal would be easily identified. The foods usually available in the given country should be included in the national tables (see annex B, paper Biro).
The international usefulness of national food composition tables considerably depends on the range of nutrients included in them. Also other factors have to be taken into consideration:

- With respect to food identification: number and type of foods, level of aggregation of foods, cooked/raw, number of recipes, mixed dishes, etc.
- With respect to nutrient values: mode of expression, analytical methods, definition, source of values (analyses, imputed), missing values, calculation procedures etc.

Sources of error related to food databases are various. A first category of problems is that of missing values. Some nutrients such as vitamin D do not appear in all food composition tables. Moreover, food composition tables never include all processed foods available on the national market. Furthermore, missing data, taken as zero lead to gross underestimates of nutrient intake. Food composition tables may lead to overestimates if vitamin losses in cooked products are not taken into account. A second category of problems is that of variability of data on contents between tables.

Such variability is both actual (due to different composition) and artifactual. There is a high need for harmonizing of analytical methods. Problems also arise when tables of food composition include both data from recent analysis and from old ones. The third category of problems is that of differences in the description of foods and definition of nutrients.

Much work has been done to improve the comparability of national food composition tables since the 1970's, thanks to International and European efforts. The International Food Data Systems Project (INFOODS), carried out within the United Nations University's Food and Nutrition Programme, provided guidelines on the organization and content of food composition tables and data bases, methods for analysing foods and compiling those tables, and procedures for the accurate international interchange of the data. In Europe, the Eurofoods initiative was developed in the 1980's to the aim of co-ordinating the manner in which food composition tables were produced in the various countries of Europe and of developing of computerised nutritional databases. This initiative received further impetus with the establishment of the Eurofoods-Enfant Concerted Action Project within the framework of the FLAIR (Food-Linked Agro-Industrial Research) Programme of the Commission of the European Community. A major deliverable from this project in co-operation with INFOODS is the work of Greenfield and Southgate (1992): Production, Management and Use of food composition data. The work of Eurofoods-Enfant project on increasing the quality of food composition databases has been continued by the five year lasting COST Action 99 since 1994. This also includes projects carried out on nutrient losses and gains in the preparation of foods (Leclercq et al., 2001; Bergström L, 1994).

The TRANSFAIR study provided reliable and comparable data on trans and other fatty acids in foods in Europe. A market basket study in 14 European countries was performed. In each country, a maximum of 100 food samples representative of the total fat intake were sampled according to a standardized stepwise approach. Samples were analysed for fat content and fatty acid composition in one central laboratory (van Poppel et al., 1998).

In the Dutch National Food Consumption Survey (DNFCS), experience is gained with the creation of specific food composition tables for the calculation of time trends. These trend tables enable valid comparisons of nutrient intake over time. They allow previous intakes to be adjusted for improvements in data and also allow a quantification of changes in nutrient intake levels resulting from various types of real changes in foods (Beemster et al., 2000).

At this moment many European projects need to establish the comparability of national food composition databases. The EPIC group has already published an inventory on food composition tables (Deharveng et al. 1999). Major conclusion was that data on total energy content could be made comparable after application of correction procedures. But the comparability between countries of individual nutrients cannot be achieved yet, because of differences in definitions, analytical methods, modes of expression etc.

3.2 How to make existing intake data more comparable

3.2.1 Food intake data (see annex B-15, paper Verger)

The existing national food consumption surveys on an individual level, which are not designed on the same basis, cannot be used directly to monitor nutrition or food intake at a European level. In spite of that, regarding the importance of food consumption monitoring as a basis for both nutritional and safety assessment, it seems important to find urgently a way to improve the comparability of national databases. The results of such comparisons would be used as a calibration method or as a first step, preliminary to a more accurate national estimate.

The current procedures for risk assessment in the field of nutrition and food safety are based on a stepwise approach with crude estimates at an international level and a more refined assessment at the national level. For the time being, intake data are the pivotal element to assess both the covering of nutritional requirement and the exposure to food additives and contaminants.

The aim of the present section is then to provide general guidelines for the comparison of food intake data using the currently available information. Such a comparison will not be conducted in the EFCOSUM project but could be recommended to the European Commission as a future work.

The parameters influencing the comparability of the results of dietary surveys are:

- the population participating (age group or whole population);
- the age of the survey;
- the way of data collection: Food Frequency Questionnaire, recall or record;
- the duration of the survey;
- the food classification system;
- the food composition table currently used.

At first, considering the results of the COST action 99, it was observed that important differences exist in national food composition databases in Europe. In the general framework of the EPIC study, IARC and compilers have started to develop the ENDB (European Nutrient DataBase) project aiming to complete a database by 2002 starting with macronutrients and extending to micronutrients in a second phase. Nevertheless, it seems rational for the present guidelines to focus the comparison of the different surveys on a ‘food intake level’ rather than at a ‘nutrient intake level’.

Annex D contains a description of all food consumption databases. An analysis of this table shows that within the 23 European countries participating to the project, 46 different food consumption surveys are available. Even if the aim of the proposed exercise consists in a crude comparison, several pragmatic assumptions need to be made in order to avoid increasing the uncertainty of the results. These assumptions can permit to select the more comparable data in a transparent way:

1. Only one survey from a considered country, will be taken into consideration. This survey will be selected as the most representative and the most recent one.

2. The current exercise will be applied only to intake data from adults, representatives of the whole adult population of a country.

3. In order to take into consideration the modifications of behaviour of the population and based on a pragmatic approach, the surveys conducted before 1990 will not be considered for the purpose of the present exercise.

4. The surveys based on Food Frequency Questionnaires will not be included.

Considering these parameters, 15 surveys remain available. Czech Republic, Greece and Spain have conducted household budget surveys but do not have data available from nation-wide food consumption surveys on an individual level. However, Greece has run the EPIC study on a national-based sample and current procedures involve the evaluation of the national representativeness of the Greek EPIC sample. Furthermore, the Norwegian survey based on FFQ and both the Belgian and the Portuguese studies conducted before 1985 can not be take into consideration.

Within the remaining databases, 7 were collected following a *recall* methodology, 7 are based on a *record* and 1 is based on a *dietary history (4 week recall and FFQ)*. The duration of the surveys varies from one day to one month. These different methodologies can be assumed to provide similar results if the comparison is based only on the first day of data collection (the use of the first day was preferred by the group of experts to a day selected randomly or a mean of the days, because in those cases a bias could affect the comparison between the 24h recall studies and longer surveys).

After exclusion of under-reporting subjects of every national survey using the same assumption, the result of such a combination of different data would provide the mean amount of food of each category, which is eaten per day and per individual in Europe. In order to improve this first result, it is possible to consider the percentage of consumers of each of the 33 broad food categories on a 24 hours' basis. This parameter can be extracted from the national studies in which it is included for a more detailed level of categorisation. The combination of the mean intake with the percentage of consumers can provide, using a multiplication factor, a good estimate of the high percentiles of the distribution of the food consumption curve (90^{th} or 95^{th} percentile).

In practical terms, a comparison of 15 surveys from 15 different European countries (10 within the E.U.) could be conducted on the food consumption of 33 food categories (see next paragraph) consumed on a 24 hours' basis. Such a comparison could permit to describe the differences between average food intake and portion size across Europe and using the percentage of consumers, provide a good estimate of the high consumption levels.

The proposed harmonization of existing data in Europe can be anticipated as sufficiently precise for a crude estimate of exposure assessment at a community level. Even if this type of data would be insufficient to fully quantify the exposure, it would be used to prioritise the actions related to nutrition and food safety in different ways:

- At first, a description of the different national European diets on the same basis and at an individual level, could highlight the major differences within the different countries, in terms of occurrence of food consumed, mean consumption per eating occasion and percentage of consumers. Such a calibration could be used to make a link between the epidemiological studies conducted in member states and to prioritize the new actions related to food and public health.

- This harmonization could also results in a more precise level of predicted exposure, than those from the FAO Food Balance Sheets. This could be used by the European Commission for simulating the impact on national food pattern of European regulation changes i.e. (for example) for the harmonization of rules for fortification of food commodities or for setting maximum residue limits for chemicals in foods.

- Another usage of this exercise would be to monitor the food consumption on a common basis and to describe, at least in relative values, the observed evolutions.

- At last, considering that both in the United States of America and in Australia, the surveys are conducted on the same duration (24-hour recall), a comparison of food ingestion and percentage of consumers could be extended to these countries. Such a comparison could have important consequences to compare public health effects related to food consumption in developed countries.

3.2.2 Food classification systems

The next step to consider (see fig 3, annex C), to find a common basis for a comparison of food intake surveys, is the food classification system that was used for data collection. A recent workshop on food identification (COST action 99, Paris, December 1999) emphasizes the problem of the level of food description, which should be published at an international level to permit intercomparisons. Based on the study of different food classification systems (Eurocode 2, WHO GEMS regional diets, FAO food balance sheet, DAFNE, Dutch National Food Consumption Survey classification (DNFCS), British National Food Survey and French national food consumption survey), the experts proposed a simplified classification baptised “EURO FOOD GROUP (EFG)” containing a list of 33 food groups, aiming for comparison at the ‘raw edible’ ingredient level. This classification is listed in table 3.1. Ireland prepared an overview in which the EFG system is compared with different existing systems. In general it can be concluded that the EFG system is compatible with these systems, and that the EFG system can be used as a starting point to come to comparable food consumption data at the food level. Furthermore, the use of the EFG system to report food consumption at the raw ingredient level, allows direct comparisons of food intake with food availability data as the latter can be derived from the DAFNE databank (see Annex B-6, paper Ireland).

In order to have an idea of the feasibility of the EFG system for regrouping the foods of available food consumption data several countries have attempted to assign straightforward the food items to the EFG system; i.e. Austria, Belgium, Croatia, Czechia, Finland, Greece, Iceland, Italy, Lithuania, Netherlands, Poland, Portugal, Slovak Republic, Spain, Sweden and United Kingdom.
The results were discussed by several experts (Utrecht meeting, January 2001). There it became clear that although everyone indicated that the EFG system could be used, further actions are needed to establish the level of comparability between the different countries and to identify further actions needed to achieve an acceptable level of comparability between countries. It should, however, be pointed out that the methodology for estimating the quantities of raw edible food (ingredient level) from the 'as consumed' data has already been carried out in the FAIR 3096 project, using the national individual food consumption data of four European countries (Belgium, Greece, Norway and the United Kingdom). The methodological considerations indicate that a number of issues need to be taken into account, before proper comparisons of the dietary data collected in the various surveys is possible (Naska et al., in press).
In table 3.2 an overview is presented of the food consumption surveys that countries would like to be included in the HIEMS system and the actual level of reporting foods is indicated.
In summary, it can be concluded that most countries report food consumption data mainly at the 'as consumed level'. This means that in many countries extra calculation procedures are needed to come to the 'raw edible' ingredient level of the EFG system. To demonstrate the impact of the different levels of reporting a comparison of reporting on the ingredient level and the 'as consumed' level of Danish food consumption data is shown (table 3.3).

In chapter 2, in the selection of a minimum set of dietary indicators four food groups of interest were identified: Vegetables, Fruits, Bread and Fish.
After comparing the different countries it appeared that Bread is usually reported as the staple food bread and is as such quite comparable. The food groups 'Vegetables', 'Fruits' and 'Fish' need a lot of corrections and recipe procedures to make these groups comparable between countries at the 'raw edible' ingredient level.

3.2.3 Food composition databases

As mentioned before, within the EPIC context a thorough comparison of food composition databases is carried out by Deharveng et al.(1999). Because all EPIC countries are also taking part in the EFCOSUM action, it seems logical to complete this EPIC inventory with data from other non-EPIC countries. Therefore a questionnaire was sent out to all EFCOSUM partners, that are not included in the EPIC inventory: i.e. Austria, Croatia, Czech Republic, Finland, Hungary, Iceland, Lithuania, Poland, Portugal and the Slovak Republic. The results of this inventory strongly confirm the already posed opinion that national food composition tables do not allow comparisons of nutrient intakes between countries. In table 3.4 the procedures to calculate the total energy content of a certain food in the different countries are presented as an example of the differences between countries.

In a survey conducted in the Nordic countries (NORFOODS, 2001, in prep.), the official nutrient calculation systems were compared. The same diet (one day) was calculated using the national (system's) data and calculation procedures. For this 'one and the same' diet major differences occur in the results due to different definitions of the nutrients, different levels of content and different energy calculation factors as demonstrated in the following table:

System	*Energy*	*Protein*	*Fat*	*Carbohydrate*	*Alcohol*	*Dietary fibre*
	kJ	*g*	*g*	*g*	*g*	*g*
1	*9167*	*111,0*	*67,5*	*262,5*	*8,4*	*24,6*
2	*7796*	*105,9*	*62,1*	*205,2*	*7,2*	*22,3*
3	*8100*	*106,4*	*59,2*	*222,2*	*8,8*	*23,9*
4	*8915*	*123,5*	*74,3*	*227,3*	*6,8*	*23,9*
5	*8695*	*105,5*	*67,2*	*246,8*	*7,6*	*29,3*
6	*8643*	*106,5*	*65,5*	*246,4*	*7,6*	*29,6*
7	8768	104,3	63,8	260,8	7,2	22,5

On the other hand, within the EPIC context, 10 countries have joined forces to come to a European Nutrient database (ENDB) in 2002: a major step towards the improvement of the level of comparability of nutrients between countries. This action is co-ordinated by IARC (WHO, France) and involves food database compilers, industrial partners, SENECA and EURALIM (Charrondière et al., 2001).

3.3 Conclusions and recommendations

At this moment there are two projects working on providing food data comparable between countries: i.e. the DAFNE group (food availability at the household level) and the EPIC group (food consumption in relation to cancer).
However, using the criteria proposed by Verger and agreed upon by the Efcosum group, a maximum of 15 countries can provide food consumption data that can be made comparable at the individual level for the whole adult population.

It is strongly recommended to make available food consumption data comparable at the food level. It is suggested to start with four food groups: vegetables (excluding potatoes), fruits (excluding fruit juices), fish (including shellfish) and bread.
Comparability of foods is only possible at the ‘raw edible’ ingredient level. The approach of the EFG system is the best compromise between the different classification systems. However, in order to achieve this, many countries have to emphasize that the amount of work needed to report their food consumption data at the raw edible ingredient level is very large.

For comparability at the nutrient level, the Efcosum group refers to the action within the EPIC context where a project is started to come to a European Nutrient database (ENDB). It is recommended to use this database to come to comparability between countries at the nutrient level.

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Table 3.1 European Food Grouping (EFG) system

Bread and rolls
Breakfast cereals
Flour
Pasta
Bakery products
Rice and other cereal products
Sugar
Sugar products excluding chocolate
Chocolate
Vegetable oils
Margarine and lipids of mixed origin
Butter and animal fats
Nuts
Pulses
Vegetables excluding potatoes
Starchy roots or potatoes
Fruits
Fruit juices
Non alcoholic beverages
Coffee, tea, cocoa powder
Beer
Wine
Other alcoholic beverages
Red meat and meat products
Poultry and poultry products
Offals
Fish and seafood
Eggs
Milk
Cheese
Other milk products
Miscellaneous
Products for special nutritional use

Table 3.2 Level of reporting foods in available individual food consumption surveys.

Country	National individual survey to be included in HIEMS	Level of reporting
Austria	?	
Belgium	-	as consumed and as ingredient
Croatia	-	as ingredients
Czech Republic	-	-
Denmark	Dietary habits of the Danes 1985 Dietary habits of the Danes 1995	as consumed
Finland	FINDIET 1997	as consumed and as ingredient
France	INCA Survey 1999	as consumed/as ingredients in the future
Germany *	German Nutrition Survey 1998	as consumed
Greece	Greek FC Survey in process	as consumed
Hungary	Hungarian Randomised Nutrition Survey (1992-1994)	as consumed and as ingredient
Iceland	National survey in 2002	as consumed and as ingredient
Italy	INN-CA study 1994-1996	as consumed and as ingredient
Ireland	IUNA-North/South Ireland FCS	as consumed
Lithuania	National Survey of 1997	as consumed and as ingredient
Netherlands	DNFCS 1997/8	as consumed and as ingredient
Norway	Norkost 1997	as ingredients
Poland	Household Food Consumption and Anthropometric Survey (2000)	as consumed
Portugal	-	as ingredients
Slovac Republic	Monitoring of dietary habits in Slovakia (1995-1999)	as consumed and as ingredient
Sweden	Riksmaten 1997-98	as consumed
Switzerland		
United Kingdom	NDNS, children 1.5-4.5 yr, 1992-3 Children 4-18 yr, 1997 Adults 65 and over, 1994-5 Adults 19-64, 2000-01 (not avail. yet)	as consumed

* dietary history (4 week recall and food frequency questionnaire)

Table 3.3 European Food Group of Danish foods. Comparison between reporting at the intake (as consumed level) and the ingredient level.

EFG g/day	Intake level	Ingredient level
Bread and rolls	142	162
Breakfast cereals	34	14
Flour	-	21
Pasta	17	8
Bakery products	39	1
Rice and other cereal products	15	7
Sugar	3	22
Sugar products excl. chocolate	16	1
Chocolate	7	7
Vegetable oils	-	4
Margarine and lipids of mixed origin	16	33
Butter and animal fats	6	8
Nuts and nut products	2	2
Pulses and pulse products	4	8
Vegetables excl. potatoes	80	99
Starchy roots and potatoes	110	119
Fruits and fruit products excl. juices	108	113
Fruit juices	156	73
Non-alcoholic beverages	587	734
Coffee, tea, cocoa powder	815	815
Beer	187	187
Wine	60	60
Other alcoholic beverages	5	5
Red met and meat products	89	111
Poultry and poultry products	14	17
Offals and offal products	1	1
Fish and seafood	22	21
Eggs end egg products	15	19
Milk	276	314
Cheese	22	31
Other milk products	55	71
Miscellaneous foods	190	5

Table 3.4 Energy conversion factors in kcal/g and kJ/g (in parentheses)

Country	Protein	Fat	Carbohydrates	Alcohol	Other factors
Austria	4 (17)	9 (38)	4 (17)	7 (29)	
Belgium	4 (17)	9 (37)	4 (17)	7 (29)	
Croatia	4 (17)	9 (37)	4 (17)	7 (29)	
Czech Republic	(16.7)	(37.7)	(16.7)	-	
Denmark (96)	(17)	(38)	(17) #	(30)	
Finland	(17)	(37)	(17)	(29)	organic acids (13) sugar OH (10)
France	4 (17)	9 (37)	3.75 (16)*	7 (29)	organic acids/ polyols 2.4-3.62 (10-15.1)
Germany	4 (17)	9 (37)	4 (17)	7 (29)	
Greece	4 (17)	9 (37)	3.75 (16) *	7 (29)	
Hungary	4(17)	9(38)	4(17)		1 kcal = 4.2 kJ
Iceland	(17)	(37)	(17)	(29)	1 kcal = 4.184 kJ
Ireland	4 (17)	9 (37)	3.75 (16)*	7 (29)	
Italy	4	9	3.75*/4	7	1 kcal = 4.184 kJ
Lithuania	4 (16.75)	9 (37.68)	3.75 (15.70)		dietary fibre 4.10 (17.17)
Netherlands	4 (17)	9 (37)	4 (17)	7 (29)	
Norway	4	9	4	7	1 kcal = 4.1824 kJ
Poland	4	9	4	7	1 kcal = 4.184 kJ
Portugal	4	9	4		1 kcal = 4.184 kJ
Slovac Republic	(16.75)	(37.68)	(15.7-17.17) $	(29.69)	1 kJ = 0.2388 kcal
Spain	4	9	4	7	1 kcal = 4.184 kJ
Sweden	(17)	(37)	(17)	(29)	
United Kingdom	4 (17)	9 (37)	3.75 (16)*	7 (29)	

* available carbohydrates (sugar and starch) expressed as monosaccharides
# dietary fibre included in energy
$ 17.17 meat, fats, legumes, cereals, flavourings
16.54 milk, sugar, vegetable, mushrooms, beverages
15.70 eggs, fruit
16.67 dishes
Dietary fibre is subtracted from total carbohydrate.

4. SELECTION OF METHODOLOGY OF FOOD INTAKE ASSESSMENT

4.1 Introduction

Dietary intake estimation encompasses the collection of information on the quantity of foods eaten, and, using figures on the food composition, the calculation of intake of energy, nutrients and possibly other components of these foods. To select an appropriate, cost effective method for the monitoring of food consumption in Europe it is important to have insight into the pro's and con's of the different possibilities and related topics. Figure 2 (annex C) presents a decision tree that might be helpful in the selection of the methodology of food intake assessment and sample size. In figure 3 (annex C) steps regarding food categorisation and food composition tables are given. The various topics are briefly presented in this chapter and discussed in detail in the background papers, included in the annexes. The numbers in the boxes of figures 2 and 3 refer to the concerning paragraphs.

Dietary information can be collected at three different levels: food supply data, data on the household level and data on the individual level. Briefly, food supply data or food balance sheets (FBS) provide gross estimates of the type and amount of food available for human consumption within a country. The values can be published as annual tonnage of the major commodities, or as amounts per head of the population.
Although household budget surveys also assess food availability rather than food eaten, in contrast to FBS household surveys can supply information on food (and nutrient) patterns in subgroups of household. These groups may be classified by economic, demographic and other factors, which provide the opportunity for risk group identification. Household budget surveys are carried out in most countries and the results on the national level are very valuable in assessing trends in food consumption. Thanks to the DAFNE project it is possible to compare the availability on the household level for several EU countries and Norway. More information on the DAFNE project is presented in the paper of Naska and Trichopoulou (annex B-9). It could be useful to examine if in the future, in parallel to recording food brought into the household, use could be made of the bar codes now carried on many processed foods and some fresh foods. When all or most shops in a country use scanners to read bar codes, it should be possible to use the data directly to monitor national food purchases. At this moment some experiments are going on (see also annex B-3, paper van Erp-Baart).
In contrast to FBS and household surveys, data on the individual level provide information on average food and nutrient intake and their distribution over well-defined groups of individuals. Data on the individual level facilitate estimating the adequacy of dietary intake and studying the relationship of diet and health (Bingham, 1988; Willet, 1998). Therefore, for the EFCOSUM project data on the individual level are preferred.

4.2 Method to be used alone or as calibration method

Several dietary methods can be used to collect dietary intake data on the individual level. Briefly, the methods can be divided into two categories, short-term and long-term instruments. Short-term dietary assessment methods collect dietary information on current intake. They vary from

recalling the intake from the previous day (24-hour recall) to keeping a record of the intake of food and drinks over one or more days (dietary record). Long-term dietary assessment methods collect information on usual food intake over the previous months or years (dietary history or food frequency questionnaire). Each method has its own strengths and weaknesses, and there is no single ideal method. The four general methods for estimation of dietary intake of individuals, with strengths and weaknesses of each method are described in the paper of Biró (annex B-1).

4.2.1 Selecting appropriate dietary assessment method for data collection in Europe

Which criteria determine the selection of a method? The choice depends on the objectives of the study; the foods or nutrients of primary interest; the need for group versus individual data; the need for absolute versus relative intake estimations; characteristics of the population (for instance age, sex, education/literacy, motivation, cultural diversity); the time frame of interest; the level of specificity needed for describing foods; and available resources. Important preconditions face the skilled interviewers and the skill for coding the foods and the adequate, complete, accurate nutrient database.

The objective of EFCOSUM is to select a method which will be used to monitor food consumption in different European populations in order to estimate average consumption of foods, but also habitual intake distribution of energy and nutrients, and (acute) intake levels of contaminants and additives. The choice of the method depends on the stated targets of the study. Since other methods are more suitable to estimate the intake of food additives and contaminants, e.g. food analyses and use of EAN codes (see also annex B-3, paper van Erp), in selecting an appropriate method these chemicals were not taken into account.
In Europe a method is needed for a reliable comparison of large population groups' nutrition. We are not seeking unspecified dietary components that may be related to health status but general features of food and nutrient intakes. As shown in annex B-14, the 24-hour recall is the most widely used method for dietary assessment because it is logical, logistically simple and suitable for large groups. The 24-hour recall is less burdening for the population and can be applied in a cost-effective way. The method yields good information on the average dietary intake of a large population. As part of EPIC the 24-hour recall has already been tested in the European context for 10 countries and seems to be applicable for all study populations in Europe. The version being applied is based on a highly standardized computer program and a common food list. From this view, the 24-hour recall is the ideal instrument for evaluating the dietary intake across Europe.

However, a single 24-hour recall is not suitable for determining distributions of habitual dietary intake. To get population distributions of habitual intake one might use repeated 24-hour recalls (see annex B-14, paper Turrini). Thereafter, habitual intake distributions are constructed by applying suitable statistical formulas and data transformations (see also chapter 6). Alternatively, food frequency questionnaires might be used which cover a long time period. However, food frequency questionnaires are usually adopted to the local study population and therefore are not directly comparable to each other in a multinational study. At least in the current stage, no long-term food frequency questionnaire is known which has been

used in the European context and which delivers sufficiently detailed dietary data adjusted for study specific bias (see annex B-4, paper Hoffmann et al.).

4.2.2 Validity of dietary assessment methods in children and older people

Dietary intake assessment of population subgroups such as children and the elderly may present special problems. In children the problems relate primarily to their ability to recall both the types and amounts of foods consumed and their ability to conceptualise portion sizes. In the elderly memory defects, sensory deficiencies (loss of hearing and vision) and neuro-musculo-skeletal diseases may impede retrospective and prospective dietary information. First, the validity of dietary intake assessments in children and thereafter assessment in the elderly will be presented. For more information, see paper of Ovesen (annex B-11).

Assessment of dietary intake in children

Twenty-four-hour recalls can be used with acceptable internal and external validity with children as the informants if the children are (7-) 10 years or older. Below that age parent's or guardian's help is necessary, and in that case the accuracy of reporting is comparable to that found in adults. Food frequency questionnaires seem to be an alternative method to assess dietary intake, however to comprehend the food frequency questionnaire children usually have to be older than 12 years. Prospective intake information is, of course, dependent on the child's reading and writing abilities. Validation studies with Doubly Labelled Water have demonstrated the 24-hour recall to be representative of energy expenditure in children while food frequency questionnaires significantly overestimate habitual energy intake. Apparently, 24-hour urinary nitrogen can not been used in children to validate intake, due to nitrogen accretion taking place during growth. Adolescents, obese subjects and female endurance athletes, seem to underestimate energy intake (individual errors in energy intake may reach 50%). There is no information to suggest that accuracy and precision of different food intake assessment methods is influenced by cultural background of children.

Assessment of dietary intake in the elderly

Several studies have been carried out to assess the internal and external validity of dietary intakes in the elderly. The observation that food intake measurement methods that rely on retrospective reports may be less suitable in older people requires confirmation. Thus, there are no hard scientific data to conclude that healthy and well-functioning elderly are faced with specific problems compared to the younger age group with respect to dietary intake assessment. None of the dietary assessment methods give accurate estimates of the usual energy requirements of individual subjects. Dietary histories and dietary records seem to underestimate food intake in the elderly as in younger age groups. Well-conducted simple methods (24-hour recall and food frequency questionnaires) for assessing group mean dietary intakes may give more accurate information than the more labour-intensive weighed dietary record. However, it must be realized that most studies have been conducted in healthy and well-functioning elderly, and none of the common methods are probably applicable in elderly with memory deficits or other disabilities. There is no information to suggest that accuracy and precision of different food intake assessment methods is influenced by cultural background of elderly people.

4.3 The role of portion size in dietary assessment

Quantification of portion sizes is one of the sources of error in collecting food intake data. This is especially the case when the assessment of food consumed must be recalled from memory. In short-term dietary methods a certain portion of food has been consumed and the validity of the method depends on the accurate recording or recall of this portion size whereas long-term dietary methods concern the concept of 'usual' portion size. In estimating portion sizes, several measurement aids can be used to help the individual to quantify the amounts of food eaten. Roughly, one can distinguish three-dimensional measurement aids, such as real food samples, food replicas, food models, household measures, and two-dimensional measurement aids such as drawings of real foods, abstract shapes, food photographs, computer graphics etc. The assessment of portion sizes will be differentiated according to reference period, i.e. short-term and long-term dietary methods. For more information, see paper of Hulshof (Annex B-5).

Portion size and short-term dietary assessment
The diversity of methods used in studies focused on the role of portion sizes makes it difficult to compare the reported outcomes. In general, studies investigating differences between actual and recalled portion sizes (using short-term dietary methodology) have shown that certain types of foods are more likely to be overestimated than others (for instance mashed potatoes, gravy) and overestimation appears to be more frequent than underestimation. In most studies overestimation tended to be greater among those who eat smaller portions and underestimation by those who ate larger portions.
Some studies have reported that women estimate portion sizes more accurately than men, but other investigators have found no differences according to gender.
Regarding the different portion size measurement aids, there is little conclusive evidence of the greater benefit of any one type. Therefore, practical reasons might affect the choice. Two-dimensional models have the advantages of being easily copied, making them appropriate for incorporation into a diary/questionnaire and making them suitable for dietary assessment in large epidemiological studies. Photographs can include a wide range of individual foods, making them highly specific and the use of a series of photographs is preferred above use of an average photograph.

Portion size and long-term dietary assessment
The concept of 'usual' portion size seems very complex. Some of the available data suggest that additional questions on portion sizes in food frequency questionnaires do not add substantially to the assessment of dietary intake whereas other data show an improvement in the relative validity. Including a specification for some foods, particularly for those that can be used in different forms, i.e. milk as beverage and milk added to coffee, might facilitate the respondents' conceptualisation. Moreover, in the importance of portion sizes also culturally based differences might play a role. This means that a careful consideration of potential advantages and disadvantages of including portion sizes in a food frequency questionnaire has to be made.

4.4 Conclusions

In conclusion, the 24-hour recall can be considered as the best method to get population means and distributions for subjects aged 10 years and over in the different European countries. For the quantification of portion sizes a picture book, including country-specific dishes, with additional household and other relevant measurements are emphasized.
To get insight into the usual intake at least two 24-hour recalls and a food frequency questionnaire to assess the non-users for infrequently consumed foods are needed.

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5. SELECTION OF FOOD CLASSIFICATION SYSTEM AND FOOD COMPOSITION DATABASE

5.1 Identification of foods

For selecting an appropriate method for food intake assessment in Europe, a common coding system is another crucial issue. Coding procedures are needed for:

- identification of foods;
- composing food groups according to specific characteristics;
- linking food composition database of any kind;
- identification of meal pattern, seasonal variation etc.

For identification of foods, up to now coding procedures are used for comparisons at the national level. Therefore, the code included in national food composition databases are used in most national food consumption surveys.
For comparison or identification of foods at a European level many different systems are developed. In paragraph 3.2 several issues with respect to food classification and the level of comparability of food composition databases in Europe are discussed. In paragraph 5.2 the issue of food classification systems for future data will be addressed. In paragraph 5.3 a summary will be presented of a grant proposal to come to a standardization of a European Food Composition Data: i.e. EUROFIR (European Food Information Resource).

5.2 Food classification or food descriptor system

In chapter 2 it is already indicated that foods as well as nutrients are important to include in the minimum selection of health indicators. For comparison at the food level a proper identification system is needed.
In the paper of Ireland and Møller (2000) some suggestions for a harmonized approach for identifying foods are made: i.e.

- internationally acceptable;
- food identification encompassing several parallel, complementary schemes;
- structured food identification;
- robust to accommodate different national languages;
- flexible for use by all users and for all types of foods;
- specific enough to avoid misclassification;
- adequately documented.

For available food consumption data the use of the EFG system is advised in order to come to comparable data on foods in a European context. Also the implications for the four most important food groups: i.e. Vegetables, Fruits (excluding fruit juices), Fish (and shellfish) and Bread are given (see paragraph 3.2)
The question arises whether the EFG system is also applicable for data to be collected in the future. Basic decision is the level of reporting. In general using a 24-hour recall, as advised earlier, the level of reporting is the level as consumed. The EFG system aims for comparability at the ingredient/raw food level. This means that certain steps are necessary to come from a 'as

consumed' level to the aimed ingredient level. The approach for estimating the quantities of raw food (ingredient level) from the ‘as consumed’ data has already been carried out in the FAIR-3096 project (see par. 3.2.2).
If the 24-hour recall will be used for the collection of the data, preharmonization of coding procedures should be established and in that way an approach is needed comparable to the EPIC. In that sense the EPIC software could be (after adaptation of the output data) a starting point for reporting the data at the ‘raw edible’ ingredient level. If the use of the software is not possible the EPIC procedures can serve as an alternative.

5.3 Food composition tables

The next step is the conversion of foods to nutrients. The prerequisites for this process are the food composition tables and databases. In general, the goals for the calculation of daily nutrient content are (1) to estimate the adequacy of dietary intake of populations or population groups, (2) to compare the nutrient supply among groups, regions, countries, (3) to study the relationships between the nutritional status and risk of diet-related diseases, (4) to evaluate the level of nutritional knowledge in the population, to have feedback on the efficacy of nutrition education, information, intervention. The nutrient intake calculated on the base of dietary recall data provides the way for an objective, reliable comparison of nutrition (see annex B-1, paper Biró).
The inventory on comparability of national food composition databases forms the basis to establish the level of comparability up to now between countries (see chapter 3). There it is clearly stated that the national food composition databases are not comparable between countries.
For the future, it is advised to concentrate on the following nutrients: total energy (protein, fat, carbohydrates), alcohol, saturated fat.
The requirement for comparable data in Europe is particularly acute for nutritional epidemiologists undertaking international studies. Their results on associations between health outcomes and dietary factors depend on the quality and comparability of the data in European national food composition databases used to calculate the intakes of nutrients and other food components from food consumption reported by the study subjects. In this respect it is worth mentioning that EPIC together with compilers are developing an ENDB (European Nutrient Database). They are starting with macronutrients and they hope to achieve a database in 2002.
Furthermore, in March 2001 a grant proposal for a follow up of this initiative is submitted to the EC by Møller et al. The objective of the European Food Information Resource, EuroFIR, project is to build a collection of comparable food composition data for the countries of Europe, supported by further information on foods and their constituents. The data will be disseminated in a range of forms suitable for all types of users, from national database compilers to the general public. The requirement for comparable data in Europe is particularly acute for nutritional epidemiologists undertaking international studies. Their results on associations between health outcomes and dietary factors depend on the quality and comparability of the data in European national food composition databases used to calculate the intakes of nutrients and other food components from food consumption reported by the study subjects.

5.4 Links to other characteristics of foods

In the above mentioned paragraphs the level of decision making is focused on foods and its conversion to nutrients. It is briefly mentioned in the introduction, but not explored in detail, that the European data collection is also aimed for policy making on other components, related to foods such as additives, ingredients, packaging components migrating into foods etc. The use of bar codes as a link to other information on foods might be an option (see Annex B-3, van Erp-Baart).

5.5 General Conclusion

For food consumption data to be collected in the future a pre-harmonization approach for coding procedures is recommended. The foods should be reported at the 'raw edible' ingredient level. The use of EPIC software/procedures is an option in this respect. If this is not possible than the EFG system is advised as a minimum level to be established.
For the conversion from foods to nutrients the ENDB can well serve as a starting point.
If the EUROFIR project is granted, a proper follow-up of the ENDB can be guaranteed.

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6. STATISTICAL ASPECTS

Within the framework of harmonization statistical aspects play an important role. An appropriate sample size, data analysis and presentation are crucial to the final outcome of a survey, particularly in comparisons between countries. Therefore, in the EFCOSUM project topics such as sample size, number of repeated measurements, estimation of usual intake distributions, uniform analysis and presentation of data and measurement of time trends were addressed.

6.1 Sample size estimation for dietary surveys

This section deals with general principles on sample size estimations, presented in the literature (par. 6.1.1) and with results from an inventory among EFCOSUM participants regarding sample size estimates (par. 6.1.2). The estimation of the sample size is always an essential step in the planning of a sample survey. In order to avoid a too large sample and unnecessary expenses, the estimation of the sample size is often the estimation of a minimum sample size necessary to achieve a precise goal.

6.1.1 General principles

There are two main steps in the determination of the sample size: the choice of the parameters or items to be estimated and the specification of the precision desired. These steps are described in detail in the paper of Volatier (annex B-16).

If a new dietary survey would take place on a European level, we should get the following information to estimate the sample sizes;

- The list of parameters of interest (mean intakes of food groups, nutrients, rates of consumers of food groups);
- The expected values of these parameters;
- The coefficient of variation or the standard deviation of these variables in previous comparable studies (for instance in previous 24-hour recall if the new project is a 24-hour recall);
- The anticipated (or previous) trends of these variables, the time period between two surveys;
- The definition of the sampling method and the identification of a design effect (cluster sampling, stratification);
- A choice of the method used for the optimal allocation of the sample size between countries (Neyman allocation, other).

6.1.2 Results of a questionnaire to estimate the sample size needed in the case of a new pan-European dietary survey for adults

The EFCOSUM working group on statistics sent a questionnaire to the EFCOSUM participants in order to estimate sample sizes for different countries. This questionnaire was divided in two parts. In the first part, opinions on the method to estimate a sample size were asked to the participants. In the second part, data on variance and Coefficients of Variance (CV's) of nutritional parameters were gathered to estimate sample sizes (see also annex F-2). Twenty countries answered the questionnaire.

Method
Regarding the method to be used to estimate the sample size the majority of the EFCOSUM participants were of the opinion that:

- The calculation on sample size should be based on the desired precision of parameters of interest and on the minimal number of people in some socio-demographic groups;
- The desired precision should be expressed in relative and absolute values;
- The sample size should be preferably a minimum size for each country with an additional part proportional to the size of the country or to the SD of the parameter of interest in each country;
- In half of the countries, a design effect has to be taken into account (stratification, cluster sampling).

Sample size calculation
The sample size calculations took into account the variability of the intakes but not the design effects. It indicates a minimum sample size of 1000 adults for fat and calcium intake and of 2000 adults for fruit and vegetable intake for a desired precision of 5%. The sample size needed increases considerably for a desired precision of 2% (up to 7000 adults for fat and calcium, 2000 adults for fruit and vegetable). For fat and calcium, the sample size needed depends on the survey methodology: it is lower for the surveys based on records. This can be explained by the precision of this type of survey or by the reduction of the intra-individual variance according to the survey duration (see par. 6.3 and annex B-4 on Nusser method to reduce intra-individual variability).

For fruit and vegetable intakes, the sample size needed doesn't depend on the type of survey. It varies between 1000 and 4000 adults according to the different countries with a median value of 2000. These broad differences between countries can be explained by the variability of food patterns among European countries. The between individuals variability of fruit and vegetables intake is higher in some countries than in others.

In conclusion, a minimum sample size of 2000 adults in each European country seems to be reasonable in order to identify trends of food and nutrient intakes.
Existing surveys show that changes of nutrient intake in an order of magnitude of 5% can exist in intervals of 4 or 5 years (DNFCS 1998 in the Netherlands, INCA 1999 in France).

6.2 Number of repeated measurements

(see annex B, paper Biro (B-1) and paper Turrini (B-14))

Intra-individual variability represents the major problem in analysing the distribution of food and food component intakes. On the other hand, it is the inherent aspect of "usual intake" that habitually varies day by day for each individual.

The problem is to capture daily variability in all consumed foods (and consequently nutrients and other food components) and at the same time to estimate the variability between subjects (intakes distribution). In fact, "one-day recall does not give correct data on habitual food consumption of the

individual, since the menu of the recall day may be atypical and have too great an effect on the results." Conversely, "when the sample is large enough, chance errors like this *(rarely consumed foods)* are levelled out and the method gives fairly reliable data on the food consumption of the whole group. The 24-h recall is most profitable when the sample is large and the diet relatively monotonous, about the same from one day to another. If the diet is varied and weekly variations are large, a one-week recall survey is not sufficient to provide reliable data on the habitual food consumption." (Pekkarinen, 1970).

In the design of large surveys, cost considerations are to be included in deciding the procedure. In practice, the costs-benefit can be optimised in two ways: increasing the number of subjects in the dietary survey, or taking the average of multiple reference measurements per subject. Beaton et al. (1979) suggested to use

$$k = \mathrm{R}\sqrt{\frac{C_1}{C_2}}$$

where k is the most effective number of repeated interviews, R is the ratio of intra- to intervariation coefficients, C_1 is the cost of recruiting a new subject into the study and C_2 is the cost of conducting and analysing a single dietary interview for a subject included in the study.

For a good estimation of habitual dietary intake a single 24-hour recall does not give sufficient data. The required number of days to classify 80% of the population into tertiles of nutrient intake is shown in table 6.1. The table shows that at least threefold 24-hour recall is required (Karkeck, 1987). Nelson et al. (1989) suggest that the number of days needed to rank dietary intake with desired precision is much higher.

Table 6.1: Number of days required to classify 80 % of the population into tertiles of nutritional intake with 95 % confidence.

Nutrient	**Range in days**
Energy	3-7
Total fat	5-9
Protein	5-7
Carbohydrate	2-4
Fibre	5-10
Iron	12-19
Calcium	3-5

Beaton and colleagues (1979) have provided a simple formula that may be rearranged to calculate the number of days needed to estimate a person's true intake with a specified degree of error 95% of the time:

$$k = (1.96\ CV_w/r)^2$$

where: k = the number of days needed per person
CV_w= the within-person coefficient of variation
and r= the relative error accepted

Using such calculations, Willett assessed the number of days needed to estimate a person's nutrient intake to lie within 40% of the true mean intake 95% percent of the time. This was calculated for total fat, cholesterol, sucrose, and vitamin A. The values range from 4 (total fat) to 26 (vitamin A) for unadjusted nutrients and from 1 (total fat) to 26 (vitamin A) for energy-adjusted nutrients (Willett, 1998). As can be appreciated, the days needed differ greatly for various nutrients.
Because of the practical impossibility of conducting such a large number of interviews, other considerations must be taken into account in choosing the number of repetitions. The subgroup for usual intake estimate suggests that only a small number of replicate measures for the 24-hour recall are needed when the effects of within-person variation are removed. To estimate the within-person variation, the number k of daily measurements per individual must be at least 2. From the statistical point of view the number k of replications and the number n of individuals should be chosen in such a manner that the confidence intervals for the percentiles are as small as possible. Since the length of such an interval decreases if n increases whereas the length is not systematically influenced by a change of k, the best choice of k is 2 by simultaneously maximise the sample size n (Willett, 1998).

6.3 Statistical procedures of estimating the usual intake distribution (see annex B-4, paper of Hoffman et al.)

The aim of the EFCOSUM project is focused on estimates of both acute and usual intake levels.
To obtain good estimates of parameters of the usual daily intake distribution, at least two strategies are possible. The first strategy is to choose a long-term dietary assessment method (Food Frequency Questionnaire (FFQ)) that is planned to produce usual intake data directly which will be improved and standardized afterwards by calibration using a method of higher validity (24-hour recalls) performed in a sub-study. The second strategy is based on repeated short-term measurements (24-hour recalls) in the whole sample to construct a usual daily intake distribution by applying modelling techniques.

The strategy of repeated 24-hour recalls should be preferred to the strategy of calibrating FFQs. The direct use of 24-hour recalls as original assessment method avoids the step of calibration, so that there is no necessity to perform an additional calibration sub-study. 24-hour dietary recall interviews have the advantages that they can be standardized (e.g. EPIC-SOFT) and that they are very flexible. Results of standardized 24-hour dietary recall interviews in different countries and in different years can be compared directly. The disadvantage of the high day-to-day variation can be eliminated by applying a correction formula and the use of a suitable data transformation. Here, the transformation procedure of Nusser (Nusser et al. 1996) was proposed for estimating the usual daily intake distribution based on short-term measurements. However, a disadvantage of the Nusser approach is that the transformation cannot be described in closed form by an explicit transformation formula. This impeded the reproducibility of the results and the widespread use of the procedure. Another proposal is to use a simplified version of the Nusser method called the best power transformation in order to obtain a good approximation of the unknown distribution function of true usual dietary intake. This simpler transformation procedure seems to be a

compromise to achieve sufficiently high accuracy and to yield an explicit transformation formula.

There remain some open problems. Especially, the approximation of the usual intake distribution for foods that are not consumed daily should be studied further. The extension proposed by Nusser et al. (1997) needs the assumption that usual intakes are uncorrelated with the frequency of consumption. Possibly, a short questionnaire to determine non-users of different foods should be added to the assessment tool of 24-hour recalls.

On the topic 'Nusser method' also an EFCOSUM workshop was organized, to calculate the statistical distribution of usual intakes. Using data from existing studies (between two and seven days of observation) for the nutrients total fat, energy, percentage of energy from fat and calcium best transformations to normality were estimated with the Box-Cox transformation and a SAS macro. For most of the surveys and nutrients studied, the logarithmic transformation seemed to be the most efficient to get normal statistical distribution intakes.
Furthermore, within- and between-individual variances of intakes were estimated with different number of days of observations. For a same survey, the parameters of the between individuals statistical distribution of usual intakes did not depend on the number of observation. It means that it is possible to estimate percentiles of intake with only two 24-hour recalls. However, the days should be non-consecutive and should preferably take into account the difference of pattern of intake between the weekend days and the other days of the week. The seasonal variation of intake should also preferably be considered but the difficulty to get intake data from different seasons for the same individuals of a national food survey was underlined (see also chapter 8).

6.4 Presentation of data

As far as existing dietary intake are concerned, data based on one day will be used (see also Annex B-15, paper Verger). This involves that standard deviations are very high. To avoid misinterpretation for existing data the following parameters are recommended:
mean, standard error of the mean or confidence intervals and proportion consumers of one day.
For data of the new pan-European survey, based on two days, parameters of interest are: mean, median, quartiles, P5 and P95.

6.4.1 Age groups

The existing surveys differ in the age-gender groups included in the survey. Furthermore, even if comparable age ranges are included, the data presentation varies among surveys as to the age-gender groups. The last aspect can be standardized relatively easy, whereas age groups classification should be based on relevant differences in risk. For nutrients the classification is mostly related to the requirements and thereby the recommended dietary allowances. The age-gender groups in these allowances are not always the same as shown by the examples in table 6.1.

Table 6.1: Three examples of age-gender classification groups

Dutch RDA (2000)

Children	*Men*	*Women*
1- 3 yr.	14-18 yr.	14-18 yr
4- 8 yr.	19-30 yr.	19-30 yr.
9-13 yr.	31-50 yr.	31-50 yr.
	51-70 yr.	51-70 yr.
		Pregnant

European Commission

Children	*Men*	*Women*
1-3 yr.	11-14 yr.	11-14 yr.
4-6 yr.	15-17 yr.	15-17 yr.
7-10 yr.	18+ yr.	18+ yr
		Pregnant, lactating

Dietary Reference Values for Food Energy and Nutrients for the United Kingdom

Children	*Men*	*Women*
1-3 yr.	11-14 yr	11-14 yr.
4-6 yr.	15-18 yr.	15-18 yr.
7-10 yr.	19-50 yr.	19-50 yr.
	50+ yr.	50+ yr.
		Pregnant, lactating

To allow smaller surveys to present the data according to standardized age-gender groups it is necessary to keep the number of groups as small as possible. Therefore, it is suggested to start with the total sample and thereafter use the categorisation of the European Commission.

6.4.2 Measurement of time trends

Changes in dietary intake over time (within a country) can be assessed by examining two or more surveys conducted at different times. Ideally, any differences in measurement procedures should be avoided. The goal to replicate data collection procedures, however, conflicts with the goal of improving the estimates of a new survey. Although within the EFCOSUM project the protocol is conducive to standardization, when considering changes in nutrient intake over time one should be aware of changes in the composition of foods. Changes in the nutrient database can be caused by real changes in the composition of a product but also by artificial changes. Real changes may represent differences from reformulations by manufacturers, agricultural (i.e. breeding) or food processing changes. Artificial changes may reflect changes in the improved knowledge regarding the composition of a food, such as improvements in the analytical techniques, better sampling method, more analyses of a specific food or information on previously unknown nutrient values. Then it is important to correct the earlier food composition estimates so that they accurately reflect the composition of foods at the time they were consumed (Guenther et al., 1994, Popkin et al., 1996, Beemster et al., 2000).

6.4.3 Non-respondents

The topic of non-respondents is described in chapter 8. From a statistical point of view some recommendations can be given on how to cope with non-respondents.

Post-stratification, e.g. the attribution of weights to respondents based on characteristics (age, gender, SES, region) should be used only when the response rates are not very different among subgroups. The weight variability should not be too high.

Non-response might also be handled in the pre-stratification by replacement of ineligible persons within the same strata.

Other options are to re-interview a small subsample of non-respondents or to get some information about non-respondents (region etc.). For more information see chapter 8.

6.5 Conclusions

In conclusion, a minimum sample size of 2000 subjects in each European country seems to be reasonable to identify the intake of nutrients and foods. To get insight into the average intake and the usual intake distribution a minimum of two 24-hour recalls is advised as well as a short questionnaire to determine non-users of different foods. For the presentation of the data parameters of interest are mean, median, quartiles, P5 and P95.

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7. DATA COLLECTION SOFTWARE

(see annex B-12, paper Slimani)

In a pan-European survey data collection should be performed in a standardized way. Since EPIC-SOFT is already developed to collect interactive dietary interviews comparable between countries, in this chapter advantages and limitations of this software programme and the possibilities to use EPIC SOFT within EFCOSUM are discussed.

The European Prospective Investigation into Cancer and Nutrition (EPIC) is a large multi-centre prospective cohort study involving about 480,000 middle-aged men and women from 10 European countries (Denmark, France, Greece, Germany, Italy, Netherlands, Norway, Spain, Sweden, United Kingdom). Information on usual dietary intakes was collected using exhaustive dietary history or food frequency questionnaires developed and validated in each of the participating countries (Overvad et al., 1991; Bingham, 1994; Margetts et al, 1997). In order to adjust, at the group level, for systematic over- or underestimation of the true mean food (or nutrient) intakes estimated by the various EPIC questionnaires, it was decided to perform an additional dietary measurement, a 24-hour diet recall (24-HDR), in a subsample of the study subjects of about 37,000 individuals (Riboli & Kaaks, 1997). One of the principal statistical requirements to use the calibration approach in the EPIC context was that the reference dietary method (i.e. 24-HDR) must be highly standardized across the 23 European countries involved in the project. A software program (EPIC-SOFT) was therefore developed to ensure the highest possible level of standardization of the 24-HDR interviews within and between centres, and increase the likelihood that, if measurement errors exist, they apply equally in all centres (Slimani et al., 1999).

Principal characteristics of the EPIC-SOFT

The EPIC-SOFT program was developed to collect interactive dietary interviews following a strictly standardized procedure to prevent or minimize systematic and random measurements error and between centres. The main characteristics of the software are that:

- information on all the foods and beverages consumed during the recall day is collected, entered, and coded automatically according to common rules;
- the software was developed to be user-friendly and convenient for use in large populations of different linguistic, socio-cultural, ethnic and geographical origin;
- the quantity of the food as finally consumed (e.g. cooked and/or without inedible part);
- systematic quality controls have to be performed throughout the interview procedure;
- standardized procedures for maintaining the EPIC-SOFT databases;
- the storage, method of retrieval and export of dietary data has to be standardized.

EPIC-SOFT provides checked, completed and comparable dietary data. The interview duration is comparable across countries (30-35 minutes to conduct a 24-hour recall, exclusive the time required to update incomplete interviews).

The EPIC-SOFT program is already available for 11 European countries (also a version exists for Switzerland, which does not participate in EPIC) and could relatively easily be extended to other non EPIC countries, if resources are available. EPIC-SOFT was designed to obtain standardized 24-hour recall interviews, and tools are already available to export them according to a common format in order to perform pooled data analyses at the food (sub-) group level. However, additional developments are required to obtain standardized nutrient intake estimates (in the current version the nutrients available is restricted to total energy and macro-nutrients; these nutrients are based on national food composition tables) and make the maintenance of the EPIC-SOFT databases independent of EPIC logistics.

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8. OPERATIONALIZATION OF A EUROPEAN FOOD CONSUMPTION SURVEILLANCE

8.1 Introduction

One of the aims of the EFCOSUM project is to harmonize and standardize the methodology for monitoring programmes with respect to food consumption in European countries. The rationale for this is that currently available data in Europe do not allow a valid detailed evaluation and/or comparisons among European countries. In previous chapters, propositions are made regarding harmonization of food intake assessment methods, food composition databases, statistical procedures and software. In the present chapter, the main conclusions and recommendations are summarised regarding the operationalization of food consumption surveys in Europe.

The term “operationalization” refers to all aspects of a food consumption survey, that are not implicitly included in the previous chapters. It covers all steps that need to be taken in order to prepare and implement the field work and carry out quality control procedures on different levels and at different stages of the survey.

It is often forgotten in setting up research or monitoring programmes, that a number of practical aspects of the implementation can substantially affect the internal and external validity of the outcome. Quite often, a large contrast can be observed between on one hand the meticulous elaboration of methods for improving the precision of biological, anthropometrical, etc. measurements and on the other hand the rather poor attention for practical elements like sampling and recruitment procedures. Yet, characteristics of a study such as participation rate, representativeness, quality of data, etc. are influenced by a whole set of practical modalities and decisions which are in varying degrees modifiable.

Within the EFCOSUM project, it was decided from the very beginning that the aspects of operationalization of food consumption surveys would be treated at the same level of priority as all other aspects and were therefore commissioned to a separate working group. This has ultimately led to a number of conclusions and recommendations regarding harmonization of the operational aspects of food consumption surveys across Europe. These conclusions and recommendations are based on a thorough study of existing literature for selected topics, on the study of the experience from other collaborative projects (see annex B-2) and on the results of two questionnaires that were distributed among the representatives from all 23 participating countries (see annex F-3, F-4 and E-1, E-2).

The EFCOSUM project is one element in a broad context of a European Public Health Monitoring programme. The ultimate aim of this programme is to use data from different pan-European projects as a starting point for developing strategies to maintain an optimal public health in all European countries. Therefore harmonization should not only be strived for across countries, but to some extent also across monitoring projects. This is the case for the operationalization aspects of these monitoring programmes, as these are to some extent common to all monitoring programmes. If, for instance, in

one project a different sampling procedure is used than in another, this may affect the validity of putting together data from different monitoring programmes in a joint perspective of public health monitoring.
It is therefore hoped that the conclusions and recommendations summarized in this chapter may also contribute to a fine tuning of operationalization aspects across different monitoring programmes in Europe.

Standardization and harmonization of practical aspects of health monitoring programmes across countries, faces a number of difficulties. A number of constraints originate from the mere fact that there are differences between countries in domains like accessibility of databases (e.g. some countries have a continuously updated population register while others don't) or like legal and/or ethical aspects with respect to privacy (e.g. in many Scandinavian countries researchers have access to a wide range of data on an individual level, which are protected under "privacy laws" in many other European countries).

Apart from this, it also seems obvious that the strive for an optimal harmonization should never encompass a reduction of the overall quality of the data in any individual country. If for instance, in one country practical administrative, ethical, legal, or any other aspects make it likely that in general population based programmes the participation rate or representativeness would usually be lower than in another country, it can not be expected from the latter country to adapt to conditions that would reduce the potential maximal quality of the results of their health monitoring programme. In other words, it has to be accepted that differences in quality of data are to a certain extent unavoidable and conditional on a number of cultural and organizational differences between countries in Europe.
This consideration has been taken into account whilst establishing the conclusions and recommendations for the operationalization of food consumption surveys in Europe.
It explains why for some of the recommendations different possibilities are put forward in a hierarchical order, starting from an ideal approach – which is known to be feasible in some countries – and allowing for less valid methods for those countries where the former approach is not feasible (yet).

8.2 Experience from other studies

With the emergence of multi-centre collaborative epidemiological research and health monitoring programmes from the 1960s and 1970s onwards, it has become increasingly clear that the issue of standardization of methods, measurements and field work is of crucial importance in order to make valid comparisons between centres or countries. The WHO-MONICA project, for instance -one of the largest projects in the field of Cardiovascular Diseases (CVD) carried out so far- was partly conceived in order to validate the official vital statistics for CVD in all participating countries; the rationale for that was the mere fact that it could not be evaluated at that time whether the observed differences in trends in CVD incidence in different countries were true differences or artefacts based on differences in methodology in different countries.
A number of other well-known international studies in the fields of cardiovascular and nutritional epidemiology have over the past decades done a tremendous amount of work in order to improve standardization across

countries. It has now become common practice to give large attention to the issue of distinguishing real differences, trends, associations, etc., from artefactual observations caused by methodological disparities or other sources of error.

For the EFCOSUM project, some of the experience and know-how developed in these studies has been taken over and adapted to the specific context of this monitoring programme. The following studies have for this purpose been taken into account: WHO MONICA-EURONUT, EPIC, CALEUR, TRANSFAIR and SENECA. The most important methodological aspects from these studies, that are relevant within the context of EFCOSUM, have been summarised in annex B-2.

8.3 Implementation of EFCOSUM

8.3.1 Sampling procedures

One of the first steps in the actual implementation of the field work for a food consumption survey is the establishment of a group of individuals that will be invited to take part in the project.
The ultimate aim of a food consumption survey is to make inferences on food and nutrient intake for a predefined target population – either the total population or a subgroup of the population – on the basis of a representative sample from that (part of the) population. Therefore, the sampling procedure must be aimed at obtaining the best possible representation of that (part of the) population, thereby taking into account that a minimal error in this representation is unavoidable for different reasons.

a. the target population
The target population is the population for which inferences will be made on the basis of the actual study results. In view of the aims and the objectives of the EFCOSUM project, this should be the best possible approximation of the population that actually constitutes a particular country in Europe. However, the concept of “the best possible approximation” is not necessarily the same in each country and therefore the definition of the target population in any given European country has to be decided by the scientists who are responsible for the food consumption survey in that particular country. From the second EFCOSUM questionnaire on operationalization, it appears that not all participating countries had the same definition for the target population within their own country. The criterion most often cited as being the basis for defining the target population is for an individual to have his/her chief residence in that particular country. More details about specific subgroups that are considered as not belonging to the target population can be found in annex E-2 (questions 1-3).
The decision on the target population has consequences for the sampling frame that will be used for drawing the actual sample of potential respondents for the food consumption survey (see b).

b. the sampling frame
The sampling frame is defined as an accessible database containing an inventory of individuals, from which a representative sample of potential participants for the food consumption survey can be recruited. The sampling frame must minimally contain all the individuals from the target population

and if it contains subjects not belonging to the target population, these must be systematically prevented from being sampled.

In practice, the sampling frame is an instantaneous cross-sectional picture of a specific population, provided to the research team by an official body. In most cases, it is neither complete nor fully up-to-date. The actual quality of the sampling frame is moreover mostly beyond control of the research team.
In the WHO-MONICA study, it has been reported that the type and the quality of the sampling frames, that are available for general population based research, is very heterogeneous in Europe (see annex B-2). This originates from the fact that there is no standardization among European countries as far as the collection and updating of demographic data is concerned.
This heterogeneity was also confirmed by the second EFCOSUM questionnaire, which made it clear that standardization of the type of sampling frame is at present not feasible in Europe. Moreover, it is suggested from the results of this questionnaire that even within the context of the same type of sampling frame, differences between countries exist in the quality, completeness and update of the sampling frames.

The recommendation from the EFCOSUM group with respect to the sampling frame is that, whenever possible, population registers should be considered as the first choice. Alternative sampling frames are census data and electoral rolls (the latter cannot be used for adolescents and children).
Whatever sampling frame is used, it should be ensured that all members of the target population are listed in the sampling frame. Moreover, the most recent available list of individuals should be used and all potential efforts to improve the quality of the sampling frame should be undertaken. The time period between the drawing of the sample and the actual field work should always be kept as short as possible.

c. single-stage versus multistage sampling
In a single-stage sampling scheme, the sampling is done in one movement and the sampling units are the individuals from the target population.
In multistage sampling, different steps in the sampling procedure are consecutively taken, whereby each step is based on a different sampling frame. An example of a two-stage sampling could for instance be a primary sampling on the basis of a list of towns and villages within a specific area, followed by a sampling of individuals within these towns and villages.
The decision on single- or multistage sampling has mainly consequences vis-à-vis the representation of subgroups or regions in the country. If for instance, within a given country the population density between regions of interest varies largely, it seems preferable to do a multistage sampling in which the level of the regions is one of the intermediate steps, so that every region of interest would be represented with the critical number of individuals needed to obtain the desired precision in the estimates (see chapter 6 on statistical methods). In the same context, it seems in general to be logical, that – if the level of towns/villages is used as one of the intermediate steps in a multistage sampling – the chance for a large town to be selected should be increased according to a specific weighting factor as compared to a small village.
Apart from these very general recommendations, every country will have to decide which procedure will eventually be used, taking into account the

global context of the choice of the target population and the relative importance of specific subgroups and/or regions within the country.

d. the age range

Although - in principle - the aim of EFCOSUM is to monitor food consumption in all age and sex groups in the general population, it was concluded that the 24-hour recall (as selected method for food consumption measurement) cannot be used in children younger than 10 years (see also chapter 4). Moreover, from the viewpoint of operationalization of the food consumption survey, it has been agreed among the EFCOSUM group that, for the purpose of nutritional monitoring programmes, children and adolescents younger than 15 years may require a different approach as compared to the adult population with respect to recruitment, interview setting and some logistical aspects of operationalization (e.g. the use of EPIC-soft). Therefore, from the operationalizational point if view it was advised to concentrate data collection on the age group of 15 years and older, and if possible for individual countries also to include the age group of 11-14 years.

The issue of grouping for age is discussed in chapter 6 on statistical aspects.

e. exclusion criteria

The exclusion criteria are a set of predefined characteristics – on individual or aggregated level – that are used as a filter during the sampling procedure in order to avoid the presence of so-called “foreign elements” (i.e. individuals who do not belong to the target population) in the final sample.

Exclusions can be done at two different stages of the food consumption survey, either during the actual drawing of the sample from the sampling frame or on the occasion of the first contact with the individuals in the sample. The former is conditional on the available information on individual characteristics that can be accessed on the level of the sampling frame database and relates in general mostly to exclusions on the basis of age, region and potentially some other a-priori defined criteria that identify individuals who do not belong to the target population.

Exclusions at the stage of the first contact with individuals from the sample relates to errors in the sampling frame and to physical and/or mental disability of subjects in the sample. This issue will be discussed in more detail in par. 8.3.2.b.

f. the actual sampling

Once the target population has been defined and decisions have been made regarding exclusions and single- versus multistage sampling, the actual sample can be established.

The model proposed by EFCOSUM is an age and sex-stratified sampling.

The starting point is the required number of individuals per stratum as defined by age and gender (see chapter 6 for further details on sample size and age groups).

It is recommended that the number of individuals drawn per stratum would be a fourfold of the required number in view of the substitution of refusals and ineligibles at a later stage (see par. 8.3.2.b). First choice individuals are drawn at random, while the potential substitutes are matched to the first choice subjects for age, sex and region (and possibly other matching variables).

As the field work would be spread over a period of 12 months to adjust for seasonal variation, it is recommended that not all individuals would be drawn at the same time but that the total sample would be established on the basis of several sampling procedures, preferably repeated once every trimester.

8.3.2 Recruitment

a. contact procedures

From the second questionnaire on operationalization (see annex E-2), it can be concluded that the way in which different countries in Europe establish the formal contact with potential respondents in the context of a nationwide nutritional survey, shows quite a heterogeneous picture – although of course based on the three elements "letter", "phone call" and "home visit". In almost all countries, the first initiative is a letter sent to respondent's home, followed by either a phone call or a home visit or both. In general, there seem to be little legal or ethical limitations in Europe with respect to the number of times or the modality of contacting people for research purposes, a notable exception of course being the fact that in most countries an informed consent has to be given by respondents. Details regarding this issue can be found in annex E-2 (questions 14-15).

The recommendation from the EFCOSUM group is that each country would use the procedures of contacting, that are most convenient, but in any case starting with an invitation letter. The latter should in most cases be accompanied by an informed consent, developed according to the prescriptions of the local ethical committees. It is further advised that it would preferably be apparent from the invitation letter that the initiative for the nationwide nutritional survey is taken from a perspective and context which is likely to stimulate people towards participation. This approach cannot be standardized across countries and the responsible scientists within each country have to decide whether or not the mentioning of specific institutes or individual names is opportune (For instance, the umbrella of the European context in the invitation letter might in some countries rather stimulate people to participate, whilst in others it may have an adverse effect).

b. issues with respect to eligibility, participation and substitution

After full exploitation of the procedures, decided in the context of par. 8.3.2.a, theoretically at least four scenarios can arise:

1. The invited person answers and expresses willingness to participate.
2. The invited person answers and expresses refusal to participate.
3. The invited person doesn't answer but via indirect information it becomes clear that the respondent doesn't belong to the target population anymore because he/she has died or moved out of the region.
4. The invited person doesn't answer and cannot be traced by the research team after several attempts.

Scenario 1 doesn't seem to require any further comment for proceeding to the actual screening, except for one potential consideration. As already mentioned in par. 8.3.1.e, exclusion of subjects from the survey can still be considered at the stage of the first contact with the individuals from the sample. This relates to two theoretical problems:

1. Exclusion of individuals who – despite the filter of a-priori defined characteristics during sampling – appear not to belong to the target population. This will in most countries apply to the group of institutionalised persons, for whom it was agreed within EFCOSUM that they would not be surveyed and who are mostly not traceable at the level of the sampling frame. This will further apply to exclusions on the basis of the inability of the sampled individual to speak one of the a-priori defined languages in a particular country.
2. Exclusion of individuals who are for physical or mental reasons unable to take part in the actual survey examinations.

Individuals excluded at this stage would be considered as “ineligible subjects”.

In case of scenario 2 (refusal for participation) it is advised to contact the individual again (provided that there is no legal constraint), either by phone or by letter, in order to get the reasons for non-response and a number of socio-demographic data from this individual that might be useful in comparing the responders with the non-responders (classical non-responder survey).

Scenario 3 can potentially cause serious problems with respect to the representativeness of the actual sample. This relates to the quality control procedures that are being followed by the official body that collects the data for the sampling frame. The older the age of the sample (i.e. the longer the time that has elapsed between the last update of the sampling frame and the actual drawing of the sample from the sampling frame), the larger the proportion of foreign elements in the sample, i.e. individuals who do not belong to the target population anymore (due to death or moved out of the region). If these subjects are not substituted in the sample, the number of respondents will accordingly be reduced and moreover, it is likely that a selection bias is introduced as mortality increases with age. These phenomena will moreover be different between countries (as the age and quality of the samples will differ between countries) and hence the comparability is affected. The problem is further aggravated if the time between the drawing of the sample and the actual screening is large and different between countries.

In the case of scenario 4, individuals are considered to still belong to the target population, but can simply not be traced on the basis of the predefined contact procedures. Examples of this are sailors who have an official address, which is however only few times a year checked on mails. This scenario can also sometimes cause a substantial decrease of individuals in the sample if the proportion of official “pro forma” residences in a country or region is relatively high (e.g. for tax reasons). Therefore, just like under scenario 3, substitution may be advised.

The term “ineligible” refers in general to the presence of individuals in the actual sample, who can not be interviewed for reasons other than a formal refusal. The definition of it can however be different from one study to another. In the WHO-MONICA Project for instance, it referred only to individuals who died or moved in the period between sampling and contact, while other categories of individuals were labelled as “not possible to

contact". These types of categorisations of individuals in the context of standardization across countries have complications towards for instance the calculation of the participation rates and the overall evaluation of the quality of the sampling procedures in different countries (detailed elaboration of this topic in annex B-2).

For the EFCOSUM project, the group of "ineligible subjects" is considered to be broader than in MONICA and includes not only individuals who died or moved, but also the individuals who had to be excluded from the sample on the basis of not belonging to the target population or being unable to participate for physical or mental reasons.

The EFCOSUM recommendation is to substitute these individuals with other individuals from the sample. For the purpose of substitution, matching should be done for gender, age and region, but other matching variables can be used as well.
The subjects described above under scenario 4 can strictly speaking not be considered as "ineligible" and for these individuals it is considered optional whether or not they should be substituted.

It can be expected that the proportion of ineligibles can vary across countries, but will in most cases be rather small. In this regard, the problem of ineligibility contrasts with the problem of formal refusals. Refusal rates in population based studies can be very substantial and can largely fluctuate over time and space and the determinants of this are only poorly understood.
Refusal induces two main problems, namely on one hand the potential introduction of selection bias in the study population and some loss of representativeness and on the other hand the deviation from the a-priori defined required sample size and the consequences of that on the precision of the estimates. In chapter 6 of the EFCOSUM report, the rationale behind the sample size calculations is elaborated in detail. In order to harmonise among countries the precision of generated estimates regarding food and nutrient intake, these sample size calculations should be the starting point for all countries in the context of a European monitoring programme.
With regard to the problem of refusal and its potential effect on the size of the study population, two strategies can theoretically be followed. One strategy could be to anticipate on the expected participation rate on the basis of previous population studies in the country and use this information as a weighting factor for decisions on over-sampling in order to come to the required number of individuals (e.g. if a participation rate of 50% is expected, twice the required number of individuals would be sampled and invited to participate). However, the main problem with this procedure is that participation rates can vary across different subgroups of the population and across different studies – also within the same country. The result of this is that the actual number of participating individuals can actually quite substantially differ from the predefined sample size - in both directions - and that the number of individuals in the different strata can be quite unbalanced.
An alternative procedure – proposed by EFCOSUM - is to start from a pool of individuals, consisting of a matched multiple of the required sample size (cf. above under par. 8.3.1). Refusals from the batch of "first choice individuals" would be replaced by "matched alternatives" and this process can progressively be repeated until the required sample size is reached.

The latter procedure is considered to be the first choice within the perspective of harmonisation of food consumption surveys on European level as it guarantees the best approximation of the predefined sample size and balance between different strata without further introduction of selection bias.
However, it is appreciated that the actual sampling procedure within each country is conditional upon a number of practical constraints with respect to availability and quality of databases that can be used as sampling frame and with respect to collaboration with existing structures or survey programmes within the country. Therefore, alternative procedures as the one described above and other variations on that theme can of course be valid to the extent that the ultimate goal of coming to the predefined sample size is taken into account in a scientifically justifiable way.

For the calculation of the participation rates, the numerator contains all actual participants and the denominator consists of all subjects that have been contacted for participation - either as “first choice” or subsequently as “matched alternative” - minus the ineligibles.

8.3.3 Fieldwork

Dietary assessment

The 24-hour recall was chosen as the preferred method for assessing the diet (see chapter 4). In order to be able to estimate intra-individual variation in food intake the recall should be repeated at least once. This has implications for the design with respect to the selection of days for the interview and the setting for the interviews. It is recommended that the first interview should be carried out face-to-face (home or research institute). The same applies for the second interview, but if feasible and valid**,** a telephone interview could be acceptable. Several studies have shown that telephone-administered and face-to-face 24-hour recalls yield comparable data (Casey et al., 1999; Tran et al., 2000). However, the validity of telephone interviews in comparison to face-to-face interviews should be evaluated more carefully, especially in countries with limited experience. Telephone interviews might be a cost-effective data collection method, especially in countries with good telephone coverage and large sparsely populated areas. If telephone interviews are conducted, the participants should be supplied with a picture book to estimate portion sizes.

A special problem with 24-hour recalls is to obtain valid data for Saturdays and sometimes Fridays. In many countries it is less feasible or even impossible to carry out a face-to-face interview on a Sunday or a Saturday (see annex E-1, question 13). An alternative would be to collect data for these days on the following Monday. Results from studies in the Nordic countries indicate that data of a subject's food intake on e.g. Saturday could be obtained by interviews on the following Monday-Wednesday (Solvoll et al., 1987; Räsänen et al. 1981, 1985, 1991). Solvoll et al. found that meal pattern and consumption on the Saturday differed from that of the weekdays, e.g. lower consumption of potatoes and a higher consumption of beverages (Solvoll et al., 1987). The results of the second questionnaire also show that food consumption on weekend days is (probably) different in most European countries compared to weekdays (see annex E-2, question 22A). Räsänen et al. used 48-hour recalls to measure food intake in children and adolescents and report that the children were able to remember their food consumption

equally well for both days (Räsänen et al. 1981, 1985, 1991). The results would indicate that it might be worthwhile to collect data for Saturdays in connection with a Monday interview. Another alternative could be to select Saturdays for a telephone interview on Sunday (provided that the telephone interview has proved to be a valid alternative and telephone interviews on Sunday are acceptable for subjects). Both methods might introduce a bias, but might on the other hand provide the possibility to correct consumption data for certain foods, which according to other valid dietary data tend to be consumed differently on Saturdays.
We recommend to conduct face-to-face interviews on Sundays as well, where possible. However, when this is not feasible either face-to-face recalls on Monday or telephone recalls on Sunday can be an alternative to cover food intake on Saturday.

Interview setting
A home visit is recommended as the first choice to collect valid dietary data. This is also indicated as the preferred option by most European countries (see annex E2, question 18). Local research or health centres are however also an acceptable option to conduct interviews.

Another issue is the length of time between the two recalls. In order to obtain data on intra-individual variation several approaches could be envisaged, e.g. random allocation of days or stratification on e.g. day-to-day variation (same week, non-consecutive days) and seasonal variation (ca. 6 months between first and second interview). Long periods between the two interviews increase the risk of dropout, and that aspect has to be taken into account when allocating interview days.
It is therefore recommended that the period between the first and the second interview should be at least one month and that different weekdays are covered. The allocation of weekdays per subject should ideally be randomised and include all weekdays.
The subjects should be informed that the project includes dietary assessments. To avoid bias, the actual interviews should be carried out in such a way the subject doesn't know beforehand that he or she will be asked about the food consumption of the previous day.

Standardization of the recall
The 24-hour recall should be performed in a standardized way. Several authors have described the selection of procedures and tools for 24-hour recalls (Callmer et al., 1986; Manual on methodology for food consumption studies, 1998). One example is the work of the NORKOST group, who published a manual on guidelines for standardization of 24-hour recall (Callmer et al., 1986).

The EPIC-SOFT programme, which was developed for computer aided face-to-face interviews in the multi-centre European prospective study on cancer, is based on standardized procedures for 24-hour recalls. The procedures and software are described in chapter 7, annex B-12 and two publications (Slimani et al., 1999 and 2000) and the main structure and principles of standardization are summarised in annex E-3.
At this moment, EPIC-SOFT seems to be the best existing software, to collect 24-hour recalls with the highest level of standardization at a European level, which is already available for 11 countries. However, as

described in chapter 7 and annex B-12, EPIC-SOFT also has some disadvantages for the aims of Efcosum and additional developments and improvements will be needed to adapt the software and make it independent of EPIC logistics. For countries not included in EPIC new country-specific versions should be developed, which is a time-consuming and expensive action. It is therefore still doubtful whether it will be feasible to use EPIC-SOFT in all European countries for a new European Food Consumption Survey. Moreover, some countries already have their own software to collect 24-hour recalls.

Considering this, we recommend the use of EPIC-SOFT as the first choice to collect 24-hour recalls in all European countries. However, if EPIC-SOFT cannot be used, other computer software and/or "manual methods" can be used to collect 24-hour recalls using the rules and procedures of EPIC-SOFT as far as possible.

Quantification of portion sizes
In chapter 4 and annex B-5 the role of portion size in dietary assessment is discussed. The use of a picture book is recommended for assessing portion sizes in a 24-hour recall.
It has become more common to use images (photographs, drawings) to aid the respondent to assess portions consumed. Nelson and Haraldsdóttir (Nelson et al., 1998a, 1998b) have reviewed this area. Factors like size of images and number of food items and portions included might affect the accuracy of the estimations. Most of the EFCOSUM countries have national picture books or portion guides and the number of foods vary between 24 to over 200 foods with 1-8 different portion sizes per food item (see annex E-2, question 20).

In the ideal situation it would be recommended to use a picture book, with the main part being equal for all countries and supplemented with country specific pictures for national dishes and/or deviant common portion sizes. If EPIC-SOFT is used for the 24-hour recalls it is recommended to use the picture book developed for the EPIC study.
However, use of national, validated tools could also be acceptable. They should at least meet the following demands:

- at least 4 portions for each food item
- inclusion of a ruler in the picture
- standardized size of the photograph

8.3.4 Biomarkers

In chapter 2 and annex B-10 the role of biomarkers as a measure of dietary intake or nutrient status is discussed. Collection of human biological samples during food consumption survey presents challenges different from collection of other samples or information. At the minimum, it requires much more active participation of the subject in a study, special safety needs and participation of some analytical laboratory (Crews et al., 1995).

Ethical needs before survey
Collection of biological samples from humans involves important ethical issues. Ethical concerns may limit the extent of investigations of individuals or a population. Ensuring confidentiality for subjects and for obtained results is strong imperative. Subjects have the right to know the implications of

their participation, the analyses to be performed, nature of the sampling procedure, use of data collected and possible ramifications of positive finding (EHC 214, 2000). This kind of survey has to be firstly approved by the appropriate responsible ethical committee (e.g. by the ethical committee of the Ministry of Health). The critical point is to recognise firstly that collection of biological samples will be invasive or not. Some routine medical procedures, such as collection of a small tube of blood, can be more acceptable to participants than some non-invasive sampling methods such as collection of a 24-hours urine specimen. This is also indicated by the results of the second questionnaire (annex E-2, question 19). When only a subsample of the selected population collects biological material, extra statistical considerations for the subsample are needed.

Safety needs before survey
Special consideration shall be dedicated to the problem of bio-safety because biological media serve as vectors for many infectious diseases such AIDS or hepatitis. Because of this hazard, special procedures must be used when samples are collected, transported, stored, analysed and finally disposed. All personnel have to be qualified or specially trained for handling with samples and special protocols have to be prepared for this purpose before the survey.

Analytical needs before survey
Use of biological markers of dietary intake in a dietary survey needs previous careful testing of validity and reproducibility of analytical methodology. The assay procedures used in study must be sufficiently sensitive, robust, free from high fluctuations and long term drift. It is therefore especially important to define the optimum conditions for whole methodology, since sampling collection schedule, sample modification and conditions for storage, time limits for analyses, systems of QA/QC, until archiving (Bates et al., 1995). Mentioned needs have to be considered in the planning of a survey. Involving of biomarkers into the dietary survey needs extra expenses, co-ordination of teams' work and involving of some other specialists.

Conclusions for use of biomarkers
Biological markers of dietary intake can be used as an optional method for many nutrients. However, the actual use of biomarkers introduces a considerable extra burden in terms of logistics, budget and approval by ethical committee and can moreover substantially affect the participation rate. Therefore, it is recommended that the collection of biomarkers is combined with some other pan-European health examination surveys and not included in Efcosum.

8.3.5 Interviewer qualifications and training

To prevent measurement errors and assure completeness and accuracy of collection of dietary data by means of a 24-hour recall, it is very important that the interviewers are correctly qualified and extensively trained for the specific study. Experienced interviewers in general may have advantages above dieticians and nutritionists with respect to improving response rates and interview techniques in general. The dietary knowledge of dieticians/nutritionists however, is very important for the quality of the dietary data. It appears to be more easy to train dieticians/nutritionists on interview experience, than to train experienced interviewers in general on

nutritional knowledge (GfK Nederland, 1998). Therefore, it is recommended that the interviewers have a thorough nutritional background, preferably graduated dieticians or nutritionists or possibly student dieticians or nutritionist in the final stage of their study. This is already common practice in most of the European countries (see annex E-1, question 14). If, however, this is not possible for a country, alternatively home economists or other skilled interviewers can be trained as dietary interviewer. Then, an extra training to improve knowledge of food products characteristics, preparation procedures (recipes) and national food habits should be given, in order to enhance the possibility to detect errors or lacking information during the interview and to correctly prepare the data for calculation.

An intensive training of the interviewers is important for several reasons (Turrini, 2000; GfK Nederland, 1998):
- to motivate the personnel by promoting consciousness of the aims of the study and the importance of collecting data correctly;
- to improve the ability to stimulate and help the participants to answer the questions correctly;
- to improve the quality of the dietary data collected by improving dietary knowledge and interview techniques;
- to standardize procedures and prevent differences between interviewers.

Therefore, the training of the interviewers should (at least) include the following elements:
- information on aim, design and background of the study;
- organizational aspects of the fieldwork;
- attitude towards the participant (creating right atmosphere, preventing social desirable answers etc.);
- the way of probing questions (e.g. preventing leading questions);
- structure of the interview;
- type of dietary information that should be collected;
- coding procedures.

If for the data collection EPIC-SOFT or another similar software program is used, the interviewer is automatically guided in the structure of the interview, and the dietary information (and to what level of detail) to be collected, while the coding is done automatically. The interviewer should be trained in using this program.
All procedures should be described in a training manual for the interviewers. In order to assure standardization between all countries, an international training workshop should be organized by the co-ordinating centre for the person per country (or study centre) who supervises the data collection. Subsequently, in each country (or study centre) a national training should be organized by the national supervisor for all the interviewers involved.
The training of interviewers with nutritional background will take about 2 to 4 days (Slimani et al., 2000; GfK Nederland, 1998). Organization of regular return meetings with all the interviewers during the fieldwork is recommended (e.g. 4 times a year), in order to reinforce motivation and stress some points of interest raised by the course of the fieldwork so far.

8.3.6 Quality control

Quality control is necessary during all steps of a food consumption survey: sampling, recruitment, data collection, data entry, data calculation and data analyses. During all these steps random and systematic errors can occur. The objective of quality control is to identify and, if possible, prevent errors

during data collection and processing and to check that all procedures are well standardized between all interviewers (within and between countries). Quality control concerns both the procedures employed and the actual data collected. Quality procedures for sampling and recruitment are discussed in par. 8.3.1 and par. 8.3.2.

Data collection
As described in par. 8.3.3, EPIC-SOFT might give the highest guarantee for standardization, and is therefore recommended as first choice, but it is doubtful whether it is feasible to use it (in all countries).
If EPIC-SOFT cannot be used, at least the rules for standardization and data control incorporated in EPIC-SOFT should be used (annex E-3). Existing other software for interactive data collection should be checked, whether it is in agreement with the main rules as used in EPIC-SOFT. If a traditional manual method is used, forms with the same structure in food consumption occasion should be developed and a detailed manual should be developed with written instructions about how to identify, describe (and to what level of detail) and quantify foods and recipes according to type of food product or dish. Also instructions should be given about checks on completeness and consistency to perform during the interview. Moreover, while in EPIC-SOFT the coding is done automatically, for a traditional manual method coding instructions should be developed (food codes and classification system; lists of weights of foods; correction factors for inedible parts and conversion from raw to cooked, etc.). A traditional manual method, however, makes a stronger appeal to the competence of the interviewer, and provides fewer guarantees for standardization between interviewers.

Besides a correct qualification and intensive training of the interviewer, it is also important that the interviewers are intensively supervised during the fieldwork. The supervisor should be accessible for questions from the interviewers with respect to the data collection and coding, and check the quality of (at least) a random selection of the interviews of each interviewer and give feed back to the interviewer about the results.
It is recommended that during the fieldwork a random selection of the participants is contacted (by telephone or letter) to check whether the interviewer really conducted the interview and the participant was satisfied with the procedures.
It is important that the data collection is evenly distributed over the days of the week and the seasons, according to the agreed plan. This should be checked regularly during the fieldwork. In case of (large) differences it can be adjusted in the planning of the next interviews.

Checks on the data set:
If EPIC-SOFT is used, data-entry is done interactively during the interview and checks and coding are performed automatically. If a traditional manual method is used, usually the data will be coded and entered after the interview. Checks on coding and data entry errors have to be performed. The following checks have to be included:
- completeness of the dataset;
- correct food (classification) code;
- coding of other variables (e.g. codes for day of the week, food consumption occasion etc.) within a specified range;

- (extremely) high or low quantities per food (classification) code, according to age group.

When these checks are performed, and necessary corrections are applied, nutrient intake can be calculated. The results of the nutrient intake should be checked on (extremely) high or low values according to age group as well. These checks should be performed per country by the supervisor of the data collection.

It is also recommended to check on differences between interviewers. This can be based on mean energy intake and should be adjusted for potential confounders such as gender, age and physical activity of the subject (Slimani et al., 2000).

Co-ordinating centre:
It is highly recommended that a co-ordinating centre is established, which is also responsible for overall quality control. All procedures for the survey (sampling, recruitment, fieldwork conditions, data collection, data processing and calculation) should be described in a manual, containing detailed instructions.
All data per country should be transferred to the co-ordinating centre in fixed formats. The co-ordinating centre should perform an overall check on completeness, consistency and outliers. The pooled data analyses should be performed by the co-ordinating centre as well.

8.3.7 Specific issues for other age groups

All aspects with respect to the operationalization of a European Food Consumption Surveillance as discussed in the previous sections, have been mainly focused on adults. For children and the elderly some adaptations might be necessary.

Children:
For children, schools may be a more efficient sampling frame than a population register or census data. Most European countries indicate that sampling of children and adolescents through schools is feasible in their country (see annex E-1, question 5). Of course, a different sampling frame also influences recruitment procedures. Sampling and recruitment through schools might positively influence participation rates. When children are involved, parents or legal guardians need to sign the informed consent. The legal age limit differs between countries, but for the majority of the countries it is 18 years (see annex E-1, question 7).
It differs between countries what interview site is preferred for children, schools or at home. This probably is also influenced by the fact whether school meals are provided or not.
Both literature (chapter 4 and annex B-11) and results of the first questionnaire on operationalization (annex E-1, question 11) indicate that 24-hour recalls can be conducted from the age of about 10 years. Below that age the parent's or guardian's help is necessary and when school meals are used, information about these meals has to be collected as well. This also influences logistics for the fieldwork. So far, EPIC-SOFT has only been used for adults. It should be further investigated whether it is suitable for children as well, or should be adapted. Other lists of food products, distinction in portion sizes, memory aids etc. might be needed.
All these aspects need to be studied further.

Elderly:
Most countries indicated that institutions for elderly and nursing homes should be excluded (see annex E-2, question 4). The proportion of elderly who live in an institution will probably differ between countries. It should be further discussed whether an upper age limit should be assigned or not, when the elderly living at home only reflect a small proportion of the total elderly population. A 24-hour recall is considered suitable for elderly as well. EPIC-SOFT however has not been used among people above the age of 74.

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9 GENERAL DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

9.1 Introduction

The European Food Consumption Survey Method (EFCOSUM) project is part of the EU Programme on Health Monitoring. The purpose of the EU Programme is to contribute to the establishment of a Community Health Monitoring System which makes it possible to measure health status, trends and determinants throughout the Community, to facilitate the planning, monitoring and evaluation of Community programmes and action, and to provide Member states with appropriate health information to make comparisons and support their national health policies. The prime rationale for the EU Programme is the development and exchange of adequate, reliable and comparable indicators of public health and the structures needed to exchange the relevant data. It is not the intention to aim for completeness from a scientific point of view.
It should be stressed that all conclusions in this chapter are based on discussions and actions carried out in the working groups and plenary meetings of the EFCOSUM group, representing the expertise available in major groups/projects all around Europe.
For food classification and statistical issues two additional expert meetings were organized. Their recommendations have also been taken into account.

9.2 Harmonization of food consumption data

The EFCOSUM project aimed at finding a new method for collecting comparable food intake data in Europe (so called pre-harmonization). In view of the need in the EU to have comparable data available as soon as possible, also attention was given to post-harmonization, i.e. making existing data comparable. Only food availability data from household budget surveys (DAFNE project) are comparable now across countries. However, there is also a need for harmonizing intake data at the individual level. EPIC developed methods to collect comparable individual dietary intake data, but this project focused on cancer and on adults only. Below we will first discuss how to make existing data comparable. Subsequently, we will show what in fact is needed to monitor food consumption in a comparable way in Europe, and what procedures are needed to reach these goals.

9.2.1 Post-harmonization of available food consumption data

In the EFCOSUM project careful consideration was given to available nation-wide food consumption surveys with nutrient intake data on an individual level. There was general consensus that there is a regrettable lack of internationally comparable data. This was in line with an earlier report by SCOOP Task 7.1.1 (1997), in which it was concluded that detailed evaluation of dietary intake in Europe is not possible, despite the fact that dietary intake data were available for most of the participating Member States. A lack of comparability of food consumption data is a well-known problem and holds for all levels of food consumption measurement.
The EFCOSUM inventory of available food consumption surveys (see Annex D) showed that different dietary assessment methods were used to collect data on an individual level. Moreover, different measurement aids to

quantify portion sizes were used – not to mention differences in age groups, and differences in statistical methods among countries.
EFCOSUM decided on the use of several pragmatic guidelines, which permit to select more comparable data in a transparent way. However, the consequence of the use of these guidelines is that only about 15 countries can provide food consumption data that can be *made* comparable. It should be realized that these data are not yet available, which can be explained as follows.
With respect to food identification and food classification, the EFCOSUM group was able to rely on experience gained in previous European projects such as EUROFOODS ENFANT, and Cost 99 Action, in which DAFNE and the IARC were also taking part. The experts in these groups demonstrated that, although within Europe a lot is achieved at the national level, comparability of countries is still far away. The development of the EFG system was therefore the next step which can be seen as the best compromise among all available food grouping systems. In the EFCOSUM context the possibilities of using the EFG system for all participating countries was further explored. It was decided that this is possible indeed, but a lot of work is still needed to provide food consumption data which are comparable at the food level within Europe.

The establishment of reliable food composition databases has also been addressed in the same previous projects, EUROFOODS ENFANT and Cost 99 Action. They achieved to set out general guidelines for the compilation of food composition databases (Greenfield and Southgate, 1992), which resulted in the establishment of food composition tables/databases at the national level in many European countries.
Deharveng et al. (1999) made an inventory on the comparability of food composition tables of the EPIC countries. This inventory clearly demonstrates that comparability at the nutrient level is not yet possible. In the EFCOSUM context, other European countries were invited to give insight into their food composition databases. The outcome of this additional inventory confirmed even stronger the conclusions of Deharveng and colleagues.
To demonstrate the impact of using different conversion procedures for calculating the energy content of foods, the NORFOODS group has made some comparisons. All these facts together clearly demonstrate that a lot is still to be done to arrive at comparable data at the nutrient level in Europe.
Up to now, the TRANSFAIR project is, as far as we know, the only project in which 14 European countries produced comparable nutrient intake data, namely for fatty acids.

Therefore, EFCOSUM states that, for the time being, post-harmonization at the level of nutrients is not a realistic option. It should be emphasized that the amount of work involved in making existing data comparable is huge. EFCOSUM recommends to start with four food groups: Vegetables, Fruits, Bread, and Fish.

9.2.2 Pre-harmonization of future food consumption data

The result of all actions within the different working groups has led to the conclusion that it is possible to come with a proposal for collecting food consumption data which are comparable at the food and at the nutrient level in the future. In this respect, some steps were taken in the different working

groups and discussed in the plenary meetings in order to come with a concrete proposal.
The first step to collect new food consumption data within the framework of a European public health programme was to identify a (minimum) set of dietary components which are relevant determinants of health. In the EFCOSUM project we wanted to identify indicators that, at a European level, are relevant with regard to their relation to health. The choice of indicators was based on the results of the EURODIET project (EURODIET, 2000). The Health Monitoring Program is very broad, and an overview of the structure of the system and its components is given in the European Community Health Indicators (ECHI) project. For each component (for example, nutrition and physical activity), indicators are identified. In these circumstances it is reasonable that for each component only a few indicators can be taken into account. Thus, a minimal list of dietary indicators was selected (vegetables; fruit; bread; fish; saturated fatty acids; total fat; ethanol; folate; vitamin D; iron; iodine; sodium). This selection was based on relevance to policy decision-making and relates to major causes of disease in the EU (CVD, cancer, osteoporosis). The prime consequence of this approach is that this set of indicators is far from complete, if we take into account all scientific evidence being and becoming available. Furthermore, most relevant indicators may change with time, indicating that it is necessary to evaluate the Health Monitoring System on a regular basis.
Critical evaluation of dietary indicators chosen led to the conclusion that for some indicators food consumption measurement is not the ideal method because they are hard to measure in the diet in a comparable way over time and across European countries (folate, vitamin D, iron, iodine and sodium) or not the most preferred variables for nutritional research (not calcium but physical activity in relation to osteoporosis). It should therefore be considered to include biomarkers of these nutrients as dietary indicators instead of dietary intake data.
As regards physical activity, this is beyond the scope of EFCOSUM and is therefore referred to the EUPASS project.
Moreover, only food groups and nutrients were selected, and not contaminants or additives. The reason is that they are not as relevant to health as foods and nutrients and that their relative importance changes more quickly over time than that of foods and nutrients. Furthermore, other methods are more suitable to estimate the intake of contaminants and additives, e.g. food analysis (duplicate diets, market basket studies) and use of EAN codes, respectively.

Now that the most relevant dietary indicators have been identified the question is how to collect data on those indicators in a comparable way. The most pertinent choice made was that data will be collected on an individual level. The major reason for this choice is the need to know who is at risk from a nutritional point of view. It should be stressed, however, that data of household budget surveys are preferred to food balance sheets since they can supply information on availability of foods in subgroups of households. HBS data are particularly valuable for trend analysis. For quick trend analyses, (commercially) available data banks based on EAN-coded food products might be an option for the future. It was suggested by the DAFNE group to conduct a pan-European food consumption survey in a sub-sample of the population already participating in the national HBS. However, the

EFCOSUM group is concerned with this approach due to the added burden on participants, resulting in a reduced participation rate and a disturbed HBS. Therefore, the consequences of such an approach has first to be tested in a pilot study.
On the individual level, the 24-hour recall interview was selected as best method to get population means and distributions. In those countries that have already their own food surveillance system, the 24-hour recall method should be used as calibration/comparison method. Moreover, in order to get information on within-person variation it is advised to repeat at least once the 24-hour recall. Furthermore, the intake distribution from two 24-hour recalls, representing short-time exposure to nutrients, can be used for modelling techniques to arrive at estimates of long-term exposure, i.e. habitual/usual intake. The simplified Nusser method is suggested for estimating usual daily intake.

Standardization is also essential for data collection, food classification and food composition tables. The EPIC SOFT program has been developed to obtain standardized 24-hour dietary recall interviews. The software is already available for 11 European countries and can be extended to non-EPIC countries. EPIC-SOFT can be considered as the most suitable software for uniform data collection in a pan-European survey. Because this software has been designed for the purposes of the EPIC study, it should be realized that this software needs to be adapted to the more general use aimed for by EFCOSUM.
However, even if EPIC SOFT is not an option, the EPIC SOFT procedures can be used. Countries that already have their own 24-hour recall software (e.g. Finland) should compare their system with the EPIC procedures to avoid differences among countries because of differences in procedures.
Concerning food classification, the EFG approach can serve as a starting point for regrouping foods within Europe. It aims for comparability of foods at the raw edible ingredient level. It is also possible, after adaptation of the output, to use the EPIC software. In general, the EPIC software makes it possible to get information about foods at different aggregation levels.
With respect to food composition tables, there is no European food composition database available yet. The EFCOSUM group recommends to make use of the work IARC has started in the EPIC context to come to one European nutrient database (ENDB). This project is supposed to be completed in 2002. A follow-up of this action can be guaranteed if the EUROFIR proposal, submitted in March 2001, is granted.
The operationalization of a survey is usually underestimated at the start of a study. It often occurs that initial decisions on procedures have to be reconsidered. These changes may have a serious impact on how to look at results of a survey. For this reason working group 4 has addressed several issues related to this topic and has formulated proposals for possible approaches.

For the future it can be investigated in which way data fusion can take place. Data fusion, in the first place, is meant to enable linkage of different databases, using key entries which are present in all of the databases and defined in the same way. After proper linkage of these databases, additional/secondary analyses can be made in order to give answers to questions which cannot be answered by simply looking at individual data sets that give insight into part of the expected problem. By combining

related health outcomes present in more databases, a more complete picture can be given.
Secondly, data fusion is also meant to identify unexpected relationships between variables included in these databases.
A quick search in the literature of the past year revealed that data fusion is already a well known phenomenon in the fields of scanning techniques, roboting, marketing research, etc. However, data fusion in relation to health monitoring issues is still to be explored.
The set of indicators described in the ECHI project can serve as a starting point for proper identification of the 'key' entries. For the time being, one can consider age, sex and sociodemographic information as possible key entries.
For finding out new relationships between well-defined variables, modelling techniques have to be applied. The identification of the appropriate techniques to do this is one of the research needs for the future.

9.3 Overall conclusions

The findings of EFCOSUM emphasize the need for co-ordinating nutritional surveillance activities within the European Union. As demonstrated, the diversity of approaches to assess dietary intake on an individual level is huge. As a consequence, available data sets on dietary intake at the country level are not directly comparable at the European level.
As a first step to come to harmonization, existing data of 15 countries can be made comparable on the level of food groups. The results can be anticipated as sufficiently precise for a crude estimate at the community level.
However, a new pan-European food consumption surveillance on an individual level based on uniform procedures and methods appears the first choice to provide comparable dietary intake data and dietary indicators appropriate for use in the HIEMS. In the meantime it is recommended that any country that will carry out a (national) food consumption survey will include the minimal amount of 24-hour recalls that allow calibration with other countries.

9.4 Recommendations for the future

9.4.1 Post-harmonization

* The following pragmatic guidelines were formulated to increase the comparability of existing food consumption data:
  - only one survey per country will be taken into consideration, which should be the most representative and the most recent one;
  - only surveys conducted after 1990 will be included;
  - only intake data from adults will be used;
  - the type of dietary assessment methods that is comparable is a 24-hour recall or a record day;
  - standardize data presentation, e.g. the age-sex groups.

* In order to find a common basis for comparability of food groups within Europe, the Euro Food Group (EFG) system was proposed as a starting point for a food classification system. This system aims for comparability of reported foods at the 'raw edible' ingredient level. Currently only very few countries are able to report foods at the ingredient level. Other countries have to convert/recalculate their data.

Because of the huge amount of work involved it is advised to start with the four food groups identified as the major food groups in relation to health monitoring:

Vegetables, excluding potatoes
fruits, excluding fruit juices
Bread
ffsh and shellfish.

* It has become very clear that comparability between countries at the nutrient level is not yet possible. The EFCOSUM group advises to wait for the European Nutrient Database (ENDB), which will become available in 2002.

* In the presentation of data the following parameters are recommended: Mean, standard error of the mean or confidence intervals and proportion of consumers on one day.

9.4.2 Pre-harmonization

* The following list of dietary indicators has been selected as a very minimum start:

Food groups:

Vegetables excluding potatoes
Fruits, including freshly squeezed, excluding bottled/canned juice
Bread
Fish and shellfish

Nutrients:

Saturated fatty acids expressed as % of total energy (%E)
Total fat (total lipids) as %E
Ethanol as g/day

Energy intake will need to be determined in order to calculate %E from total fat and saturated fatty acids.

* The 24-hour recall interview was selected as the best method to get population means and distributions. The 24-hour recall should be repeated at least once and should not be conducted on consecutive days. Furthermore, it should be distributed over one year to adjust for seasonal variation. Portion sizes should be quantified by using a picture book, including country-specific dishes, with additional household and other relevant measures. Additional questions should be added for foods that are infrequently consumed in order to estimate the proportion of non-users.

* Sampling frame

With respect to sampling frames, population registers should be considered as the first choice. Alternative sampling frames are census data and electoral rolls (the latter cannot be used for adolescents and children).

After the target population has been defined and decisions have been made regarding exclusion and single- versus multistage sampling, the actual sample can be established.

* Sampling size
  A minimum of 1000 subjects are needed for the establishment of total fat (total lipids) intake and of 2000 subjects for fruit and vegetable consumption to achieve the desired precision of 5%. This means a starting point of at least 2000 persons per country.

* Presentation of data
  In the presentation of data, parameters of interest are mean, median, quartiles, P5 and P95.

* Age range
  It has been agreed that, for the purpose of nutritional monitoring programmes, children under 10 require a different approach and that for nutritional monitoring it is recommended to concentrate in the first place on the age group of 11 years and older with no upper limit. According to the categorization used by the Scientific Committee for Food (1993), this group should be split up in age groups of 11–14, 15–17 and 18+.

* Recruitment
  It is concluded that recruitment procedures cannot be standardized across countries. However, it is advised to start at least with an invitation letter followed by personal contact, either by a visit at home or by a telephone call. For comparison of responders with non-responders it is useful to get a number of sociodemographic data from the non-responding individual.

* Fieldwork
  Fieldwork should be carried out in the best possible standardized way, bearing in mind the following issues:
    Training of personnel
    Defining the level of standardization of 24-hour recall
    Decision on type of picture book for quantification of portion sizes
    Quality control

* EPIC-SOFT
  After adaptation to the more general purposes of health monitoring, EPIC-SOFT might give the highest guarantee for standardization across countries. If EPIC-SOFT cannot be used, at least the rules for standardization and data control incorporated in EPIC-SOFT should be used. Existing other software for interactive data collection should be checked for compatibility with the main rules as used in EPIC-SOFT.

* Food classification
  It is advised to use the EFG system as a minimum level of comparability in reporting at the food level. However, if EPIC-SOFT is chosen, then some parts of the output need to be adapted to the more general EFCOSUM approach.

* Food composition database
  The establishment of the ENDB is a sine qua non for conversion of foods to nutrients. The EFCOSUM group also stresses the importance

of granting the EUROFIR proposal as the best approach for a follow up of the ENDB.

* The simplified Nusser method should be used to estimate the usual intake distribution from two 24-hour recalls.

* Biomarkers
  Biomarkers should be considered for the following micronutrients:
  Folate
  Vitamin D
  Iron
  Iodine
  Sodium

  Based on ethical, safety, analytical and practical considerations, it is recommended that the collection of biomarkers is combined with other pan-European health examination surveys.

* The following steps can be defined in order to come to combining the data sets, i.e. data fusion:
  - identify the type of health indicators included in the ECHI overview;
  - identify the possible logical and physiological relations between these indicators;
  - look for the 'key' entries, which will enable you to establish links between different databases;
  - identify the definition level of these 'keys'. In the ECHI it is already identified that the indicators are defined at the generic level and that it can be expected that this might differ among the different countries;
  - if these 'key' entries are covering different 'population' groups, then there should be a possibility to come to the same level between these countries.

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