1.2 Introduction

The project, Scientific Co-operation (SCOOP) Task 3.2.11: Assessment of the dietary exposure to arsenic, cadmium, lead and mercury of the population of the EU Member States, was decided in October 2001 and commenced in January 2002. The objective of the task is to provide the scientific basis for the evaluation and management of risk to public health arising from dietary exposure to arsenic, cadmium, lead and mercury. This requires the identification of the major dietary sources of these elements and the estimation of the intakes by both the whole population and by any high-risk subgroups for each Member State.

The Joint FAO/WHO Expert Committee on Food Additives (JEFCA) has established Provisional Tolerable Weekly Intakes (PTWI) for cadmium, lead, mercury and methylmercury. These may be compared with the intake estimates obtained from the different Member States. The outcome of these comparisons is an indication of the risk for hazardous exposure run by the citizens in the Member States.

The EU Scientific Committee for Food reports in its Opinion on Cadmium (thirty-sixth series. 1997) great concerns regarding its limited ability to assess the dietary exposure, due to lack of reliable consumption data. It concludes, however, that a significant part of the population has an intake of cadmium, from dietary sources alone, that is close to the PTWI. For lead the Committee concludes (Opinion on Lead, thirty-second series. 1994) that the level of contamination of foodstuffs does not seem to be a cause for alarm. It does, however, note that the reasons for extremely high levels, which are occasionally found in foodstuffs, need to be indentified. Long term action should follow with the objective of further lowering the lead levels in foodstuffs.

In the context of the Scientific Co-operation the Commission of the Member States proposed a specific task on lead, cadmium, mercury and arsenic. Italy and Sweden accepted a joint Co-ordinatorship and were assigned the task by a Commission Decision of 26/10/2001.

Member States contributing to the scoop project

BELGIUM	BE
DENMARK	DK
FINLAND	FI
FRANCE	FR
GERMANY	DE
GREECE	HE
IRELAND	IR
ITALY	IT
THE NETHERLANDS	NL
NORWAY*	NO
PORTUGAL	PT
SWEDEN	SE
UNITED KINGDOM	UK

*Norway is not distinguished from Member States in this report.

Intake data was primarily submitted for the mean adult population in the Member States. Some Member States submitted data also for certain other population and age groups. See Table 1.1. for details.

Table 1.1. Arsenic, cadmium, lead and mercury. Intake data reported for different population and consumer groups in the Member States

Population	BE	DK	FI	FR	DE	HE	IR	IT	NL*	NO	PT	SE	UK
Adult. Mean		X	X	X	X	X	X	X	X	X	X	X	X
Adult. High Level				X	X	X	X			X	X		
Children (4-6 years). Mean.					X								
Children (4-6 years). High level.					X								
Children (10-12 years). Mean.					X								
Children (10-12 years). High level.					X								
Children (3-14 years). Mean				X									
Children (3-14 years). High level				X									
Children (14-18 years). Mean	X												
Children (14-18 years). High level	X												
Consumers													
Adult. Mean				X	X	X	X			X			X
Adult. High Level				X	X	X	X			X			X
Children (3-14 years). Mean.				X									
Children (3-14 years). High level.				X									
Children (4-6 years). Mean.					X								
Children (4-6 years). High level.					X								
Children (10-12 years). Mean.					X								
Children (10-12 years). High level.					X								
Children (14-18 years). Mean.	X												
Children (14-18 years). High level.	X												

*For cadmium and mercury only.

Spain declined further participation at an early stage of the project. Austria did not submit data. The Netherlands decided not to submit occurrence data for arsenic and lead.

Institutes in the Member States provided the latest national information in accordance with the agreed format. The information to be collated was primarily concerned with:

- The concentration of arsenic, cadmium, lead and mercury in foodstuffs.
- Food consumption data at the national levels.
- Dietary intake of the elements at Member State level.

1.3 Legislation

Maximum levels

The Commission Regulation (EC) No 466/2001 adopted in March 2001, established maximum levels (MLs) of cadmium and lead in certain foodstuffs and mercury in fish products. The regulation is in force since 5 April 2002. The Commission Regulation (EC) No 221/2002 of February 2002 amended maximum levels of cadmium, lead and mercury in certain fishery products. A revaluation of the MLs will begin in 2003. For arsenic no ML is yet established.

Compliance with MLs for cadmium, lead and mercury in the Member States
A comparison with the MLs for cadmium, lead and mercury will be made for foodstuffs for which MLs are established. The results will be found in sections 3.5, 4.5 and 5.5, repectively. When data in tables 3.6, 4.6 and 5.6 differ from those in other occurrence data tables it may be due to differences in reporting by the Member States, or by the interpretation by the coordinators.

Criteria for sampling, sample treatment and methods of analysis
The Commission Decision 90/515/EEC laid down the reference methods for detecting residues of cadmium, lead and arsenic. Subsequently, the Commission Directive 2001/22/EC of 8 March 2001 laid down criteria for the sampling methods and the requirement to be met in sample treatment and analysis of cadmium, lead, and mercury for the official control of their levels in foodstuffs. Several established analytical methods are available which comply with these requirements.

1.4 Estimation of food consumption

There are various types of data describing food consumption. Household budget surveys generally cover amounts of foods brought into the household and refer to the food as purchased, i.e. no information on preparation methods and actually consumed amounts. In individual dietary surveys different methods are used covering short periods or more long-term intake. Here the aim is to cover the actual amounts consumed.

Food consumption data derived from various studies were used to calculate the intake of mineral elements. Several Member States had access to national representative surveys, whereas others had more limited studies at their disposal. These data were combined with occurrence data, e.g., consumption of 0.25 kg of a foodstuff containing 0.100 mg As/kg represents an intake of 0.025 mg As. Only food consumption data for which occurrence data exist were used. Analytical data should according to agreement be validated and up to date. In certain cases older data could be used, provided their quality could be verified.

1.5 Dietary intake of elements

The consumption of food within the various food groups, for which there are occurrence data available, varies considerably between the Member States and regions, as can be seen in Tables 2.1, 3.1, 4.1 and 5.1 These differences must, however, be viewed with caution since the number of specific food items in each food group can vary considerably between countries. For example, Greece has occurrence data only for dried and preserved fruit in the food group "Fruit and vegetables", Sweden has occurrence data only for table wine in the food group "Beverages". The consumption of milk in Germany appear to be only a fraction of what is consumed in the other Member States, but is based only on the consumption of dry milk. Information on the UK food groups can be found in the UK's consumption and intake section in *Annex A*.

Provisional Tolerable Weekly Intakes (PTWIs) has been established for cadmium, lead and mercury. They are based on per kg bodyweight, but, for simplicity, often given for a person weighing 70 kg. To facilitate a more precise calculation the mean body weight of adults in the participating Member States are shown in table 1.2. It should be noted that the mean weight is different between males and females and that the age brackets may vary between Member States.

Table 1.2. Age brackets applied in the different Member States and the mean body weight of Member State subjects, in kg. Data from national surveys.

Member State	Age (years)	Male (kg)	Female (kg)	Mean M/F (kg)
Belgium	14-18	60.7	59.1	60
Denmark	15-80			72
Finland	25-64	84.3	69.9	77.1
France	3-14	31.26	31.96	31.6
France	15+	73.88	60.11	66.4
France. Total population	3-15+	55.09	49.46	52.18
Germany	10-14			41
Germany	18+			70.5
Greece				70
Ireland				75
Italy				70
The Netherlands	1-97			65.8
Norway	16-79/18-79			73
Portugal				
Sweden		80.8	66.6	73.7
United Kingdom				70.1

The Member States may have national standards for intake estimations, based on criteria different from those used in this report. It may be noted that e.g. the UK does not use population estimates for comparison with safety guidelines, but merely to look at exposure trends over time. Total consumer estimates is used instead of comparison with the PTWI. The compilations used in this report are primarily made to facilitate comparison between Member States.

It must be observed that occurrence and intake data are reported using different units throughout this report - mg and µg.

1.6 Evaluation of the results

The occurrence data submitted by the participants were checked by the co-ordinators. In cases where analytical data showed signs of being unusual, or otherwise deviating from what is normally found in reports, they were discussed with the participant and in many cases verified. In some cases data were withdrawn.

Most of the participants had reported information from their analytical quality control (AQC) programmes, i.e. results from the analysis of certified reference materials (CRMs) and from participation in proficiency testing (PT) programmes. These results were used to validate the occurrence data. All AQC-data are found in ***Annex A.***

The participants also submitted information on the methods of analysis. A large array of methods was used. Samples were mostly wet digested using mineral acids, either in closed vessels under pressure or open vessels at atmospheric pressure. Dry ashing was also utilised by some laboratories. The four elements were mostly determined by atomic absorption spectrometry (AAS), generally using graphite furnace techniques for Cd and Pb and vapour generation techniques for As and Hg. Many, but not all, laboratories reported the use of background correction during the analysis. Inductively coupled plasma – mass spectrometry (ICP-MS) was used by some laboratories. In PT certain foods, e.g. potatoes, were analysed with methods having extremely high detection limits (≤1 mg/kg). Since half of that limit is used as the occurrence level for the intake calculation, intake may erroneously appear to be very high. All method descriptions are found in ***Annex A.***

The information submitted to the co-ordinators is in most cases freely accessible via reports or international publications. The references to available reports are found in ***Annex A.*** Information on occurrence, consumption and intake data for arsenic, cadmium, lead andmercury, as submitted by the Member States is found in ***Annex B.***

1.7 Limiting factors

During the course of the project several factors were identified that will affect the interpretation of the result of the SCOOP-project. The most important factors are listed below.

Missing data.
During the collection of occurrence data for the various foodstuffs it became clear that the Member States has no common approach for the acquisition of necessary analytical data. DK and the UK had sufficient occurrence data for a full intake study, whereas all other Member States were lacking data for some, or most, food groups.

Skewed food groups.
When food groups only contain a single, or a few, food items the intake calculation can be severely distorted by a food item with an unusually high/low level of the analyte and being consumed in small/large quantities.

Quality of submitted data.
In many cases unusually high (in some cases unusually low) occurrence data were not verified by submitted AQC-data. Unreliable occurrence data can result in both over- and underestimation of the intake of toxic elements.

Limit of detection.
For the purpose of intake calculations it was generally agreed to assign results below the LOD half of that value (e.g. <0.05 = 0.025). Some Member States, however, used other interpretations. In the UK, available data are calculated as equal to the LOD (e.g. <0.05 = 0.05). Denmark uses the the mean value of the actually measured individual determinations below the LOD. As a result some intake calculations may be under- or over-estimated. It also adds to the general uncertainty of the intake estimates.

Estimation of consumption.
The comparability of the exposure data is hampered by several factors, e.g. type of food consumption data, representativity of population studied, period of collection of analytical data and missing data. The method used for measuring food consumption influences the quality and reliability of data and also affects the interpretation of intake estimations. In many instances food consumption is underestimated, when methods such as dietary records, 24 h recall and fixed food frequency questionnaires are used.

1.8 Conclusions from SCOOP task 3.2.11

Arsenic. Fish and other seafood is the main source of As in the diet of the mean adult population. The daily intake from fish and other seafood is estimated to be below 0.35 mg (<2.5 mg/week). Marine species of fish may have As-levels more than ten times higher than that in fish from e.g. brackish water. Fish and other seafood contribute more than 50% to the mean intake. Consumers of fish and other seafood may reach an intake of 1 mg/day (7mg/week), or more. No data on the level of inorganic As in fish and other food is presently available.

Children have a lower intake than adults, according to data from FR and DE, and young children (4-6 years) have the lowest intake. Since children have lower body weights, their body burden/kg may, however, be higher than that of adults.

Cadmium. None of the most consumed foodstuffs are generally high in Cd. The intake by the mean adult population in the Member States is estimated to be less than 30% of the PTWI, with the exception of NL (38%). Cereals, fruit and vegetables, meat and fish are the main sources of cadmium in the diet, as they are highly consumed staple foods, even if the level of cadmium is generally low. Liver and kidney (especially equine) crustaceans, mollusc and cephalopods generally contain higher levels of cadmium. The contribution of offal and molluscs to the cadmium dietary mean intake is small, as the consumption is low. Regarding high level consumers of offals and molluscs, it is necessary to promote finalized study to assess the relative risk.

Children have a lower intake than adults, according to data from FR and DE, and young children (4-6 years) have the lowest intake. Since children have lower body weights, their body burden/kg may, however, be higher than that of adults.

Lead. None of the most consumed foodstuffs are generally high in Pb. The intake by the mean adult population in the Member States is estimated to be 0.042 mg/day (0.29 mg/week), which is equal to a mean of 17% of the PTWI. The intake in PT is considerably higher than the average (54% of the PTWI). This high intake is strongly influenced by use of inappropriate analytical methods resulting in very high LODs. In e.g. IR, the intake is underestimated (0.4% of the PTWI) since occurrence data were available only from a few food items.
Specific foodstuffs from some Member States were reported to contain very high lead levels. If these high occurrence levels are confirmed, or the sampling found to be representative, consumers in these Member States may be at risk of exceeding the PTWI.

Children have a lower intake than adults, according to data from FR and DE. Young children (4-6 years) have the lowest intake. Since children have lower body weights, their body burden/kg may, however, be higher than that of adults. In DE the body burden for children aged 4-6 years is 1µg/bodyweight/day (35% of PTWI), whereas the body burden for adults is 0.6 µg/kg bodyweight/day (19% of PTWI). Children who are high consumers of certain foodstuffs may run a risk of exceeding the PTWI.

Mercury. Fish is the main source of Hg in the diet, followed by fruit and vegetables. The daily intake of total Hg by the mean adult population is estimated to be below 0.015 mg/day. Six Member States presented mercury intake data on fish products only. No data was available for organic mercury-species (i.e. Methylmercury). Predatory fish species generally contain higher levels of mercury. However, the contribution of these foods to the dietary mean intake is small, since the consumption is low. Two Member States has reported high intakes from fruit and vegetables. These intakes, however, also include data from mushrooms and dried products which may increase the mean content in this food group more than relevant.

Regarding high level consumers of these products, it is necessary to promote finalized study to know the consumption of the most contaminated foods for the higher consumers groups.

Children have a lower intake than adults, according to data from FR and DE, and young children (4-6 years) have the lowest intake. Since children have lower body weights, their body burden/kg may, however, be higher than that of adults and intakes may appear to exceed the PTWI for methylmercury in 4-6 years old. However, the data submitted were for total mercury and the relative proportions of methylmercury to the total mercury in the different foods need further investigations. This would allow for more accurate intake estimates in relation to methylmercury.

The Member States lack a common, co-ordinated, approach for the analysis of foodstuffs and collection of validated results for the purpose of establishing background data for intake calculation/estimation.

A large number of confounding factors were identified during the work on the project. These confounding factors may artificially increase the intake levels considerably, or they may reduce the intake levels. The interpretation of the results from this project must therefore be viewed with caution.

Commission regulation 466/2001. In some foodstuffs occurrence data are occasionally exceeding the ML. Exceedings give the appearance of being sporadic rather than systematic.

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1.10 Glossary

AQA	analytical quality assurance
CRM	certified reference material
CV-AAS	cold vapour - atomic absorption spectrometry
DA	dry ashing
ETA-AAS	atomic absorption spectrophotometry-electrothermal atomization
FAAS	flame atomic absorption spectrometry
GC- QFAAS	gas-chromatography-quartz furnace atomic absorption spectrometry
GC-MS	gas-chromatography-mass-spectrometry
GF-AAS	graphite furnace - atomic absorption spectrometry
HG-AAS	hydride generation – atomic absorption spectrometry
ICP-AES	inductively coupled plasma - atomic emission spectrometry
ICP-MS	inductively coupled plasma - mass spectrometry
LOD	limit of detection
LOQ	limit of quantification
PT	proficiency testing
PTDI	provisional tolerable daily intake
PTWI	provisional tolerable weekly intake
SCF	scientific committee for food
SCOOP	scientific co-operation on questions relating to food (directive 93/5/EEC)
VM	voltammetric methods
WG	wet digestion