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Harmonization of food categorization systems for dietary exposure assessments among European children

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3 26 **Abstract**
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6 27 Within the European project called EXPOCHI (Individual food consumption data and
7 28 exposure assessment studies for children), 14 different European individual food
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9 29 consumption databases of children were used to conduct harmonised dietary exposure
10 30 assessments for lead, chromium, selenium and food colours. For this, two food
11 31 categorisation systems were developed to classify the food consumption data in such a way
12 32 that these could be linked to occurrence data of the considered compounds. One system
13
14 33 served for the exposure calculations of lead, chromium and selenium. The second system
15 34 was developed for the exposure assessment of food colours. The food categories defined for
16
17 35 the lead, chromium and selenium exposure calculations were used as a basis for the food
18 36 colour categorisation, with adaptations to optimize the linkage with the food colour
19 37 occurrence data. With this work, an initial impetus was given to make user-friendly food
20 38 categorisation systems for contaminants and food colours applicable on a pan-European
21 39 level. However, a set of difficulties were encountered in creating a common food
22 40 categorisation system for 14 individual food consumption databases that differ in type and
23 41 number of foods coded and in level of detail provided about the consumed foods. The work
24 42 done and the problems encountered in this project can be of interest for future projects in
25 43 which food consumption data will be collected on a pan-European level and used for
26 44 common exposure assessments.
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39 46 **Keywords:** exposure assessment; children; Europe; food categorisation; EXPOCHI; food
40 47 colours; lead; selenium; chromium
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46 49 **Short title:** Harmonized food categorisation systems
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52 Introduction

53 In the area of chemical food safety, food categorisation systems are used to link food
54 consumption data with occurrence data of adverse chemicals present in foods, such as
55 additives and contaminants. Such food categorisation systems are needed since occurrence
56 data and food consumption data are often not available at the same level of detail.

57 Food consumption data are mostly collected for different purposes (e.g. monitoring
58 population intakes of a range of macro- and micronutrients). Broad food categorizations that
59 are not at a very detailed level of food description may suffice for these purposes. However,
60 in the field of food safety, occurrence data of e.g. additives and contaminants can be
61 collected at a different level of detail (e.g. at food or ingredient level). Use of broad food
62 categories may then hamper the linkage with food consumption data. For example, additives
63 are often analysed or set in specific foods (sometimes at brand level) as described in
64 regulations, whereas trace metals are often analysed in raw foods, such as milk, meat, etc.
65 Linkage of these occurrence data to food consumption data requires a conversion of
66 consumption levels at food level to that at the level of raw ingredient (Boon et al., 2009). In
67 addition are contamination or concentration data (e.g. for food colours) in general over-
68 estimated when they are aggregated at broad food groups because trace elements for
69 instance are in general measured in foods that are supposed to contain the element or to
70 have a high content of this substance. Furthermore, the level of detail present in food
71 consumption surveys may be limited since subjects cannot always provide all the required
72 information of what they have consumed (definitely when retrospective dietary intake
73 assessment methods were used). Obtaining detailed information among children is even
74 harder as they have only a limited capacity to recall their own food intake and parents are
75 often unable to know what their child consumed at school or in the kindergarten. Therefore
76 food consumption data are often available without all the detailed information needed to
77 perform exposure assessments, what will result in an increase of the uncertainty in the
78 resulting exposure outcome.

79 To link food consumption and occurrence data to assess the exposure to chemicals
80 present in food, often foods consumed and those analysed are categorised in such a way
81 that the most optimal link between both databases is established. Different categorisation
82 systems are available for this, such as the categorisation system described in the SCOOP
83 Tasks Report 3.2.11 (European Commission 2004) used to assess the exposure to different
84 mycotoxins and the Concise European Food Consumption Database developed by the
85 European Food Safety Authority (EFSA) (EFSA 2008), which has been used to assess the
86 exposure to numerous chemicals, such as ochratoxin A (EFSA, 2006), arsenic (EFSA,
87 2009b), cadmium (EFSA 2009c) and lead (EFSA 2010).

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3 88 Food categorisation is a crucial activity to allow for processing of food consumption data,
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5 89 because it is not possible to interpret dietary data without aggregating individual food items
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7 90 into food groups, either before (close-ended survey forms, e.g. food frequency questionnaire)
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9 91 or after (open-ended forms, e.g. diary) the collection of food consumption data.
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11 92 Categorisation of food items implies the identification of foods and their characteristics in
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13 93 order to put the most similar items in the same category of the developed food categorisation
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15 94 system (Turrini 1999; Møller and Ireland 2008). The experience in the food data processing
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17 95 field has shown the necessity of developing different food categorisation systems related to
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19 96 the objectives of the study (Møller and Ireland 2008).

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19 97 From November, 1st, 2008 until November, 30th, 2009, EFSA funded a research project
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21 98 aiming to create a relational network of different individual European food consumption
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23 99 databases of children (aged 1 to 14 years) and to perform dietary exposure assessment
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25 100 studies. Within this project, called EXPOCHI (Individual food consumption data and exposure
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27 101 assessment studies for children), fourteen individual food consumption databases
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29 102 representative for diverse regions/countries within Europe were harmonized in order to use
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31 103 the consumption data for four specific exposure assessment studies, i.e. for lead, chromium,
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33 104 selenium and a set of food colours. In total, 14 partners covering 13 European countries
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35 105 participated in the project. Food consumption data was derived from 24-h dietary recalls and
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37 106 dietary records. More information about the consortium, rationale, methods and design of this
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39 107 project can be found in a separate paper (Huybrechts et al. 2010).

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38 108 Within the project, the different scientific partners provided the food consumption
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40 109 databases, whereas EFSA was responsible for the occurrence databases of the substances
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42 110 under study. To be able to conduct the requested exposure assessment studies in a
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44 111 standardized way, the 14 different consumption databases were harmonised by categorising
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46 112 all food items in common food groups. To optimize and harmonize the food linking in the
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48 113 EXPOCHI project, a food categorization manual was made. With the use of the manual, a
49
50 114 standardised procedure of linking different European consumption databases with one
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52 115 European occurrence database per compound was established. Two food categorisation
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54 116 systems were developed within the project: one for the exposure assessments to lead,
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56 117 chromium and selenium and a second one for the food colours. In this paper, both
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58 118 categorisation systems as well as the difficulties encountered are described and discussed.

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58 120 **Materials and methods**

59 121 *Two different food categorisation systems and manuals*

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3 122 Within the EXPOCHI-project, it was the aim to conduct harmonised dietary exposure
4 123 assessment in children living in different European countries. Therefore, procedures were
5 124 developed so that all partners categorised their food items in a standardized way. Two food
6 125 categorisation systems were developed, both described in detail in two extensive manuals:
7 126 an EXPOCHI-manual on Food Categorisation for (1) Lead, Chromium and Selenium and (2)
8 127 Food Colours (freely available on request).

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14 128 To apply the two food categorisation systems, first a list of unique food items as coded in
15 129 the food consumption databases needed to be generated, containing – if available – details
16 130 such as preparation, fat content (e.g. for milk), etc. Each food item in this food list was
17 131 defined by a unique name (preferably in the local language as well as an English translation)
18 132 and a unique food code. Starting from this food list, food items needed to be categorised in
19 133 food groups, as defined in the food categorisation system by means of a data entry method
20 134 described in the manuals. For this it is important that the characteristics of the foods as
21 135 enclosed in the name of each food item are known in order to be able to categorise the foods
22 136 correctly. During the categorisation, no difference was made between foods eaten at home
23 137 or out-of-home, since those details were missing in most food consumption databases.

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31 138 To develop the categorisation procedure and set up the manuals, preliminary samples of
32 139 the 14 food lists obtained from the national food consumption databases and received from
33 140 each partner in the EXPOCHI-project were explored to foresee problems and difficulties that
34 141 partners would encounter during the categorisation work. These possible problems and
35 142 difficulties were listed in the manuals and solutions were provided. Moreover, due to these
36 143 food list samples, examples of food items from all geographical regions under study (e.g.
37 144 specific local food items) could be included in the manuals. The manuals were continuously
38 145 updated during the project to address all difficulties experienced during the categorisation
39 146 work in the participating countries.

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46 147 To illustrate the results of the food categorisation work, data from four different individual
47 148 food consumption databases are presented covering a North-European country (Sweden), a
48 149 West-European country (Belgium), a South-European country (Italy) and an East-European
49 150 country (Czech Republic). For Sweden, the data were collected in 2003 by a nationwide food
50 151 consumption survey conducted among children aged 3 to 4 and 7 to 13 years (Enghardt-
51 152 Barbieri et al. 2006). The Swedish consumption databases consisted in total of 1548 different
52 153 food items. The Belgian food consumption data used in this project were collected in 2002-
53 154 2003 from a representative sample of Flemish children aged 2.5 to 6.5 years (Huybrechts et
54 155 al. 2008) and consisted of 1056 different food items. The Italian food consumption data were
55 156 collected during the period of 2005-2006 for children aged 1 to 10 years (Leclercq et al.

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3 157 2009). The Italian food consumption databases consisted of 1530 different food items. In
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5 158 Czech Republic, a food consumption survey was conducted between November 2003 and
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7 159 2004 with children aged 4 to 14 years (Ruprich et al. 2006). This database counted 515
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9 160 different food items, primarily aggregated for the national total diet study focused mainly on
10 161 contaminants. For more details on the databases see Huybrechts et al. (2010).
11 162

14 163 *1. Lead, chromium and selenium*

15 164 The food categorisation system for lead, chromium and selenium was based on the food
16 165 categorisation system described in the SCOOP Tasks report 3.2.11 (European Commission
17 166 2004). The groups mentioned in this SCOOP report are based on definitions from the Codex
18 167 General Standard for Food Additives (GSFA) developed by the Codex Alimentarius
19 168 Commission (Codex Alimentarius Commission 2009). The document describes the
20 169 conditions under which permitted food additives may be used in all foods, whether or not
21 170 they have previously been standardised by Codex. However, for the EXPOCHI-project, those
22 171 definitions needed to be adjusted since foods in consumption databases are generally
23 172 mentioned 'as eaten', whereas the definitions found in GSFA are mentioned 'as product in
24 173 the food manufactory'.
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33 174 34 175 *1.1. Main group and subgroups*

35 176 The lead, chromium and selenium categorisation system consisted of four hierarchical
36 177 grouping levels: main group (MG), subgroup 1 (SG1), subgroup 2 (SG2) and subgroup 3
37 178 (SG3) and one descriptor: special code (SC). This structure is in accordance with Turrini
38 179 (Turrini 1999), distinguishing two types of food coding variables: hierarchical codes and
39 180 crosswise codes. Hierarchical codes aim at identifying the type of products (food group,
40 181 subgroup), while crosswise codes are dedicated to the description of the characteristics
41 182 (packaged or not, fresh or preserved, etc.).
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48 183 The hierarchical categorisation process applied in this project was divided into two
49 184 consecutive steps. Firstly, a main group was defined per food item in the food list. These
50 185 main food groups and their definitions originated from the GSFA, describing 16 main groups
51 186 (Codex Alimentarius Commission 2009). Two extra main groups 'Vegetarian meat and fish
52 187 substitutes (MG17)' and 'Miscellaneous: foods that cannot be placed in categories (MG18)'
53 188 were added to make it possible to categorise all food items occurring in the national food
54 189 consumption databases. Table 1 lists all main groups defined in the food categorisation
55 190 system for the lead, chromium and selenium exposure calculations. In the EXPOCHI manual,
56 191 the GSFA definitions were reported, including extensions of the definitions to clarify the main

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3 192 groups more clearly. A short list of food items to be included in a certain food group and of
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5 193 some to be categorised elsewhere illustrated these definitions. The first step was complete
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7 194 when all food items had been assigned to one of the 18 main groups.

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9 195 The second step consisted of categorization at subgroup level, which included a refining
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11 196 of the main group categorisation by means of maximum three subgroup levels: SG1, SG2
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13 197 and SG3. Figure 1 shows an example of subdividing MG 10 (Eggs and egg products) into
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15 198 four different groups on the level of SG1 (10.1, 10.2, 10.3 and 10.4) and two different groups
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17 199 on the level of SG2 when considering SG1 = 10.1 (i.e. fresh eggs): 10.1.1 and 10.1.2.

18 200 As is shown in Figure 1, the explanation per main group began with a brief summary
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20 201 based on which it was decided to which subgroup a food item belonged. This was followed
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22 202 by a diagram demonstrating the structure of all subgroups within one main group. Every
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24 203 decision taken during the categorisation work was checked by the given definitions.

25 204 It was not always possible to categorise each food item at all three subgroup levels (SG1,
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27 205 2 and 3), due to two reasons: (1) not all main groups were subdivided into a second and third
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29 206 subgroup level, and (2) not all national food consumption database provided enough detail
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31 207 for each food item to be able to categorise it at a next (or lower), more detailed, subgroup
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33 208 level. An illustration of this can be found in the example given in Figure 1, for SG2 of the
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35 209 group 'fresh eggs' (10.1). Most food consumption databases did not include details on
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37 210 whether eggs originated from indoor or outdoor reared eggs. Therefore, in those cases, the
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39 211 categorisation stopped at the level of SG1.

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43 213 1.2. *Special code*

44 214 An extra variable 'special code' (SC) was added as a descriptor for five main groups to
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46 215 add relevant information that was not included in the categorisation system based on MG,
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48 216 SG1, SG2 and SG3. This special code indicated the presence of a specific component (e.g.
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50 217 chocolate filling) or a physical state (e.g. powdered form), and was applied within the
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52 218 following five main groups: MG4 (fruits, vegetables, seaweed, nuts and seeds), MG7 (bakery
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54 219 wares), MG9 (fish, fish products, molluscs, cephalopods, crustacean and echinoderms),
55
56 220 MG13 (foodstuff intended for particular nutritional use) and MG14 (beverages). If food items
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58 221 contained more than one component/filling a combination of numbers was used by placing
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60 222 the numbers in ascending order. A special code indicating the presence of soy in a food was
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224 224 used for all main groups. Table 2 lists all special codes that were applied in the framework of
this project.

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3 226 1.3. *Link with occurrence data of lead, chromium and selenium*

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5 227 During the project, it emerged that EFSA was not able to provide the occurrence data for the
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7 228 contaminants lead, chromium and selenium categorised according to the food categorisation
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9 229 system described in the SCOOP Tasks report 3.2.11 (European Commission 2004) but only
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11 230 according to the categorisation used in EFSA's Concise Food Consumption Database (EFSA
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13 231 2008). Due to the huge number of occurrence data resulting from food testing in the different
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15 232 Member States (94,126 for lead, 23,750 for chromium and 47,858 for selenium), EFSA
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17 233 considered it inconvenient to reclassify all food descriptors in the occurrence database
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19 234 according to the SCOOP system. A link was therefore needed between the newly developed
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21 235 food categorisation system and that of EFSA's Concise European Food Consumption
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23 236 Database. Efforts were made to keep the anticipated major food contributors for lead,
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25 237 chromium and selenium in different food categories and, at the same time, to minimise the
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27 238 need for the reclassification of food descriptors. This resulted in a list of 42 communal food
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29 239 groups (Table 3) making it possible to link the food consumption data to the occurrence data.
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31 240 The main group and subgroup together with the special code were subsequently re-
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33 241 organized, as well as certain food items in such a way that the concentration data per
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35 242 communal food group were representative for the food items in those food groups.
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244 2. *Food colours*

245 The food categorisation system as specified in the Council Directive 94/36/EC (European
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247 Commission 1994) was used to develop a system to classify all food items present in the
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249 different national food lists in order to perform dietary exposure assessments for food colours.
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251 This food colour classification system was tuned to the Flavourings, Additives and food
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253 Contact materials Exposure Task (FACET) project (<http://www.ucd.ie/facet/>). Occurrence
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255 data were provided by EFSA according to this categorization system.

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257 Within the EXPOCHI-project, 41 different food colours were considered for exposure
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259 assessment. All, except lycopene, could be approached by one categorisation system based
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261 on 84 different food groups (Table 4), partly based on the Council Directive 94/36/EC and
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263 partly developed particularly for this project using the information of the FACET project (i.e.
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265 to further divide the category 'all other foodstuff' in more detailed categories) (European
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267 Commission 1994; Oldring et al. 2009). Of the 84 food groups, 16 were not taken into
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269 account within the EXPOCHI-project because the age group addressed in the exposure
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271 assessment to food colours was limited to children aged 1 up to 10 years (e.g. food groups
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273 like 'spirituous beverages', 'whisky', 'liqueurs' were irrelevant for this age group). The 68 food
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275 groups that were considered in the EXPOCHI-project are marked in Table 4.

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3 261 As stated, a separate food classification system was developed to classify foods for the
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5 262 lycopene exposure assessments. Since naturally occurring lycopene was not considered in
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7 263 the exposure analyses, the system included only food groups in which lycopene could be
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9 264 added as an additive. The food groups differed from those used for the other food colours on
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11 265 the level of aggregation. For example, lycopene is permitted in all types of bread, whereas
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13 266 for the other food colours, only malt bread was considered (see Table 4 and 5). Compared to
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15 267 the general food colour categorisation system, fewer food groups were needed to classify the
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17 268 food items for lycopene, since addition of lycopene is only permitted in a limited number of
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19 269 food groups (in total 33 food groups; see Table 5).

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21 270 The food list including the main groups and subgroups of the food classification
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23 271 system for lead, chromium and selenium formed the starting point for the food colour
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25 272 classification system. Around half of the food items occurring in the food lists from the
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27 273 different EXPOCHI-partners belonged to a MG-SG combination that could be re-
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29 274 coded as a whole in one single food colour group. For example, all food items in the
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31 275 food group 10.1 'Fresh eggs' (see Figure 1) belonged to the food colour group 0 'No
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33 276 food colours'. For the food items belonging to such a MG-SG-combination, the re-
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35 277 coding into the food colour categorisation system could be performed automatically.
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37 278 In contrast, for the other part of the food items, the categorisation into the food colour
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39 279 groups was less straightforward, because food items within a similar MG-SG-
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41 280 combination did not belong to a similar food colour group. For example, the food
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43 281 items classified in 9.4.1 'Fish canned in oil' could belong to different food colour
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45 282 groups (FCG): fish roe belongs to FCG=16; surimi belongs to FCG=15 and fish past
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47 283 belongs to FCG=12. This second step of the classification was performed according
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49 284 to guidelines included in the second categorisation manual.
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52 286 **Results**

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55 288 To illustrate the results of the food categorisation, data are shown for four of the 14
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57 289 different countries: Belgium, Italy, Sweden and Czech Republic; and for two categorisation
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59 290 systems: the one for lead, chromium and selenium and the one for lycopene. A first important
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291 remark is the huge difference in the total number of food items entered in the different food
292 consumption databases. The Czech databases contained the least number of food items
293 (n=515), followed by Belgium with 1056 different food items, Italy with 1530 and Sweden with
294 1548 food items.

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3 295 Table 3 shows the percentage per country of food items classified in each communal
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5 296 food group for the lead, chromium and selenium exposure assessment. These results show
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7 297 first of all that not all 42 communal food groups were needed to classify all food items. For
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9 298 example, the communal groups 9 'Food supplements' and 34 'Other food for special dietary
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11 299 uses' were used by two of the four countries, whereas group 26 'Other seafood' was only
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13 300 used by Italy. Another difference was the percentage of food items in communal food group 2
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15 301 'Vegetables'. This percentage was low for the Italian database compared to the other
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17 302 countries, whereas the percentage of food items in group 3 'Waters' was high in Italy.

18 303 Results are also shown for the lycopene categorisation based on these four national
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20 304 consumption databases (Table 5). Table 5 indicates that some food groups were not needed
21
22 305 by any of the four countries, such as groups 31 'Salmon substitutes' and 37 'Edible cheese
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24 306 and edible casings'. The table also indicates that the percentage of food items to which
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26 307 lycopene could be added differed considerably between the different databases, being
27
28 308 around 40% in Belgium, 31% in Italy and Sweden, and 22% in Czech Republic.

29 309

30 310 **Discussion**

31 311

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33 312 In this paper, we described the food categorisation systems that were developed and
34
35 313 applied to categorise 14 different food European consumption databases of children in the
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37 314 ages of 1 up to 14 years in order to prepare them for an exposure assessment study of three
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39 315 contaminants (lead, chromium and selenium) and a set of food colours. Although different
40
41 316 food categorisation systems already exist (Møller and Ireland 2008), none could be applied
42
43 317 without any modification. The work described in this paper illustrates that food categorisation
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45 318 systems can differ substantially depending on the compound under study, as described
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47 319 earlier (Turrini 1999): the food classification system developed for the contaminants differed
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49 320 on many aspects from the one developed for food colours (e.g. number of food groups,
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51 321 composition of food groups, number of food items per food groups).

52
53 322 The unique aspect of the food categorisation work performed in this project is that food
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55 323 items present in 14 different consumption databases for European children were categorised
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57 324 in a uniform way, making it possible to estimate the exposure to the chemicals under study in
58
59 325 a uniform way. The food consumption databases used in this study were derived from
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326 different studies performed at the national / regional level. These databases differed on many
327 aspects, including dietary assessment methods used and age ranges addressed. Another
328 important difference, which affected the food categorisation (and consequently the resulting
329 exposure calculations), was the way in which the primary dietary information was recorded
330 and aggregated into food items and (sub) food groups. Due to this, the level of detail

1
2
3 331 available of the foods present in the national / regional consumption databases differed
4
5 332 greatly. The examples used in this paper to illustrate the approach show that the different
6
7 333 food consumption databases differed much in the number of food items entered. For
8
9 334 example, the Italian and Swedish databases contained up to three times more food items
10
11 335 than the Czech database. The number of food items gives an indication of the level of detail
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13 336 present in the database. For example, in some databases 'milk' can be the only entry,
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15 337 whereas in other databases milk can be entered as 'milk, skimmed', 'milk, semi-skimmed'
16
17 338 and 'milk, whole'. Moreover, some food consumption databases contained details as brand
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19 339 names (e.g. of confectionary), additives (e.g. yoghurt with or without sugar), etc. whereas
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21 340 others did not. In fact, the attention paid either to specific food categories (e.g. supplements)
22
23 341 or to specific food components could affect the level of food description for the corresponding
24
25 342 groups. An additional remark concerns whether the transformation from composite food to
26
27 343 ingredients was performed or not. This operation could lead to vary the number of food
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29 344 items. Overall, the more details available, the better and more detailed the categorisation
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31 345 work could be performed.

32
33 346 To address the heterogeneous databases, two detailed manuals were developed, which
34
35 347 contain explanations and examples aiming to minimize the chance of misclassifications.
36
37 348 Difficulties during the project were discussed, resulting in updated version of the manuals.
38
39 349 These manuals address many differences in food items entered in national / regional
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41 350 databases and can be very valuable when developing food categorisation systems to be
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43 351 used in pan-European food consumption surveys. The development of such a food
44
45 352 consumption survey is one of EFSA's long-term objectives (EFSA, 2009).

46
47 353 To be able to link the categorised food consumption data with the lead, chromium and
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49 354 selenium occurrence data received from EFSA, foods categorised according to the
50
51 355 hierarchical food categorisation system were generalised to 42 communal groups. During
52
53 356 this process, certain details on the foods entered in the different regional/national food
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55 357 consumption databases were inevitably lost. Due to this, the link between the foods
56
57 358 consumed and those analysed will not be optimal, affecting negatively the representativity of
58
59 359 the ensuing exposure results. It is therefore important, for an optimal exposure result, that
60
360 both the food consumption and occurrence data are categorised at the highest level of detail
361 possible. In practice however, often either the consumption data or occurrence data are
362 categorised at a level that makes an optimal link not feasible. During the interpretation of the
363 exposure results obtained with such data, this should be taken into account. If for instance
364 the level of coding is too low there is a danger of assuming that all foods within that category
365 contain the highest level. Alternatively it could be assumed that all foods contain average
366 levels and so missing the true high-level individual.

1
2
3 367 Also the food categorisation system developed for the exposure assessments to food
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5 368 colours, started from the detailed, hierarchical system developed based on the food
6
7 369 categorisation system described in the SCOOP Tasks report 3.2.11 (European Commission
8
9 370 2004). However, the food groups needed to be recoded to the groups specified in the
10
11 371 Council Directive 94/36/EC (European Commission 1994). In the first step, scripts could be
12
13 372 used to reclassify automatically about half of the food items in the food lists from the
14
15 373 hierarchical system to the groups of the food colour system. This was a time-saving
16
17 374 procedure and it reduced the chance of mistakes (like typing errors).

18
19 375 Next, it should be noted that the precision of matching occurrence and consumption
20
21 376 categories can have a major impact on the uncertainties introduced into the model. For the
22
23 377 food colour exposure assessment, the most important source of uncertainty was the use of
24
25 378 'maximum permitted level' data in the worst case scenario, resulting in an overestimation of
26
27 379 the exposure, also due to the use of very broad food groups. Also for the other components
28
29 380 (lead, chromium and selenium), it is very likely that the exposure was overestimated due to
30
31 381 the use of broad food groups. How large this overestimation is, is difficult to predict, since no
32
33 382 information on the specific foods that were analysed was available. However, the approach
34
35 383 used in this project is the best approach presently possible and is a major step forward
36
37 384 compared to national risk assessments performed in the past.

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39 385 This issue needs to be taken into consideration when making national comparisons since
40
41 386 the level of detail in food description will vary between surveys. Therefore, compromises are
42
43 387 needed to be made between loss of precision caused by including as many countries as
44
45 388 possible or improved accuracy but only within those countries that have highly detailed food
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47 389 descriptions. Additionally, future exposure assessment studies should focus on the
48
49 390 development of a total diet study based on the core foods method which allows to get
50
51 391 contamination data more in line with food really consumed.

52
53 392 Overall, the authors believe that they have a positive bias in the calculation method, that is a
54
55 393 conservative bias. The reason for this is that the occurrence values are often based on
56
57 394 targeted sampling of problem products that will influence the overall mean upwards. As
58
59 395 described in the manuscript, the authors also did some considerable adjustment to exclude
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61 396 typical adult products rarely consumed by children.

62
63 397 Although the limitations mentioned above should always be considered when interpreting
64
65 398 results derived from the EXPOCHI project, this project delivered important data for analyses
66
67 399 in the field of exposure assessments in children in Europe, and was a first and valuable step
68
69 400 that needed to be done to proceed from a country specific view to a European view.
70
71 401 Acknowledging the shortcomings of the current system, EFSA has three main activities
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73 402 under way to address this: (1) the development of a harmonised food description and
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75 403 categorisation system that at least should be able to translate different approaches into a

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3 404 common output; (2) the dissemination of guidelines developed on how to harmonise food
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5 405 consumption data collection; (3) and finally the development of a guideline for a total diet
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7 406 study approach to get baseline occurrence data. However, these steps are part of a long-
8
9 407 term strategy that will not happen overnight.

10 408 **Conclusion**

11
12
13 409 In this paper we describe two food categorisation methodologies, one for contaminants
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15 410 and one for food colours. The difficulties associated with the creation of a single food
16
17 411 categorisation system for several heterogeneous food consumption databases, and possible
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19 412 solutions, were highlighted. The work performed illustrates that food categorisation systems
20
21 413 differ depending on the compound under study and that the categorisation work is influenced
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23 414 by the level of detail present in the food consumption databases. Without good planning of
24
25 415 objectives for food consumption studies and effort devoted to concerted food categorisation
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27 416 activities in places where occurrence data are produced or collected, the considerable lose of
28
29 417 information and higher uncertainty of exposure assessment have to be expected.
30
31 418 Nevertheless, the developed systems are an important step forward to reach the goal of a
32
33 419 pan-European food categorisation system to perform harmonised exposure assessments at
34
35 420 a European level. The best way forward will be by means of a common categorization
36
37 421 system based on hierarchical systems for both, food consumption and also concentration
38
39 422 data.

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41
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43
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45
46 426 the FACET project for their advice and input when setting up the categorisation systems.
47
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49
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431 **References**

- 432 Boon PE, Ruprich J, Petersen A, Moussavian S, Debegnach F, van Klaveren JD. 2009.
433 Harmonisation of food consumption data format for dietary exposure
434 assessments of chemicals analysed in raw agricultural commodities. Food
435 Chem Tox 47: 2883-2889.
- 436 Codex Alimentarius Commission. Codex General Standard for Food Additives (updated up to
437 the 32nd session of the Codex Alimentarius Commission) [Internet]. 2009.
438 Available at: <http://www.codexalimentarius.net/gsfaonline/index.html>
- 439 EFSA. 2006. Opinion of the Scientific Panel on contaminants in the food chain on a request
440 from the Commission related to ochratoxin A in food. EFSA Journal 365: 1-56.
441 Available at: [http:// www.efsa.europa.eu](http://www.efsa.europa.eu)
- 442 EFSA. 2008. Guidance Document for the use of the Concise European Food Consumption
443 Database in Exposure Assessment. EFSA/DATEX/2008/01 [Internet]. Available
444 at: <http://www.efsa.europa.eu/en/datex/datexfooddb.htm>
- 445 EFSA. 2009a. General principles for the collection of national food consumption data in the
446 view of a pan-European dietary survey. EFSA Journal 2009; 7(12):1435.
447 Available at: <http://www.efsa.europa.eu>
- 448 EFSA. 2009b. Panel on Contaminants in the Food Chain (CONTAM). Scientific opinion on
449 arsenic in food. EFSA Journal 7: 1-198. Available at: <http://www.efsa.europa.eu>
- 450 EFSA. 2009c. Scientific Opinion of the Panel on Contaminants in the Food Chain on a
451 request from the European Commission on cadmium in food. EFSA Journal 980:
452 1-139. Available at: <http://www.efsa.europa.eu>
- 453 EFSA. 2010. Scientific Opinion of the Panel on Contaminants in the Food Chain on a
454 request from the European Commission on lead in food. EFSA Journal 8: 1570.
455 Available at: <http://www.efsa.europa.eu>
- 456 Enghardt-Barbieri H, Pearson M, Becker W. 2006. Riksmaten – barn 2003. Livsmedels - och
457 näringsintag bland barn i Sverige (with a summary in English). Uppsala:
458 Livsmedelsverket.
- 459 European Commission. 1994. European Parliament and Council Directive 94/36/EC of 30
460 June 1994 on colours for use in foodstuffs. Official Journal of the European
461 Communities L 237/13.
- 462 European Commission. 2004. Reports on Tasks for Scientific Cooperation (SCOOP) Task
463 3.2.11. Assessment of the dietary exposures to arsenic, cadmium, lead and
464 mercury of the population of the EU Member States Directorate General Health
465 and Consumer Protection [Internet]. Available at:
466 [http://ec.europa.eu/food/food/chemicalsafety/contaminants/scoop_3-2-](http://ec.europa.eu/food/food/chemicalsafety/contaminants/scoop_3-2-11_heavy_metals_report_en.pdf)
467 [11_heavy_metals_report_en.pdf](http://ec.europa.eu/food/food/chemicalsafety/contaminants/scoop_3-2-11_heavy_metals_report_en.pdf).

- 1
2
3 468 Huybrechts I, Matthys C, Pynaert I, De Maeyer M, Bellemans M, De Geeter H, De Henauw S.
4 469 2008. Flanders preschool dietary survey: rationale, aims, design, methodology,
5 470 and population characteristics. *Arch Public Health* 66:5-25.
6
7
8 471 Huybrechts I, Sioen I, Boon PE, Ruprich J, Lafay L, Turrini A, Pilar A, Hirvonen T, De Neve
9 472 M, Arcella D, Moschandreas J, Westerlund A, Lourdes RB, Hilbig A, Papoutsou
10 473 S, Christensen T, Oltarzewski M, Virtanen S, Rehurkova I, Azpiri MA, Sette S,
11 474 Kersting Mathilde, Walkiewicz A, Serra-Majem L, Volatier JL, Trolle E, Tornaritis
12 475 M, Busk L, Kafatos AG, Fabiansson S, De Henauw S, van Klaveren JD. 2010.
13 476 Dietary Exposure Assessments for Children in Europe (the EXPOCHI project):
14 477 rationale, methods and design. *Arch Public Health*, Submitted.
15
16
17
18 478 Leclercq C, Arcella D, Piccinelli R, Sette S, Le Donne C, Turrini A. 2010. The Italian National
19 479 Food Consumption Survey INRAN-SCAI 2005-06. Main results in terms of food
20 480 consumption. *Public Health Nutr* 12(12):2504-2532.
21
22
23 481 Møller A, Ireland J. 2008. LanguaL 2008 – The LanguaL Thesaurus. EuroFIR Technical
24 482 Report D1.8.21b. LanguaL European Technical Committee and the EuroFIR
25 483 Consortium [Internet]. Available from:
26 484 [http://www.eurofir.org/eurofir/Downloads/LanguaL/LanguaL2008/LanguaL%20](http://www.eurofir.org/eurofir/Downloads/LanguaL/LanguaL2008/LanguaL%20008%20Thesaurus.pdf)
27 485 [008%20Thesaurus.pdf](http://www.eurofir.org/eurofir/Downloads/LanguaL/LanguaL2008/LanguaL%20008%20Thesaurus.pdf)
28
29
30 486 Oldring PKT, Castle L, Franz R. 2009. Exposure to Substances from Food Contact Materials
31 487 and an Introduction to the FACET Project. *Deutsche Lebensmittel-Rundschau*
32 488 105(8):501-507.
33
34
35 489 Ruprich J, Dofkova M, Rehurkova I, Slamnenikova E, Resova D. 2006. Individual food
36 490 consumption - the national study SISP04 [Internet]. Prague: CHFCH NIPH.
37 491 Available from: <http://www.chpr.szu.cz/spotrebapotravin.htm>
38
39
40 492
41 493 Turrini, A. 1999. "Food coding in nutritional surveys." Pp. 361-366 in *Classification and Data*
42 494 *Analysis: Theory and Application. Proceedings of the Biannual Meeting of the*
43 495 *Classification Group of Società Italiana di Statistica (SIS) Pescara July 3-4 1997.*
44 496 Edited by M. Vichi and O. Opitz. Berlin Heidelberg: Springer-Verlag.
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Figure Caption:

Figure 1. Example of the layout of the main food group 'eggs and egg products, including four subgroups on the level of SG1 and two subgroups on the level of SG2 when considering SG1 = 10.1 (i.e. 'fresh eggs')

For Peer Review Only

Chapter 10

Eggs and egg products

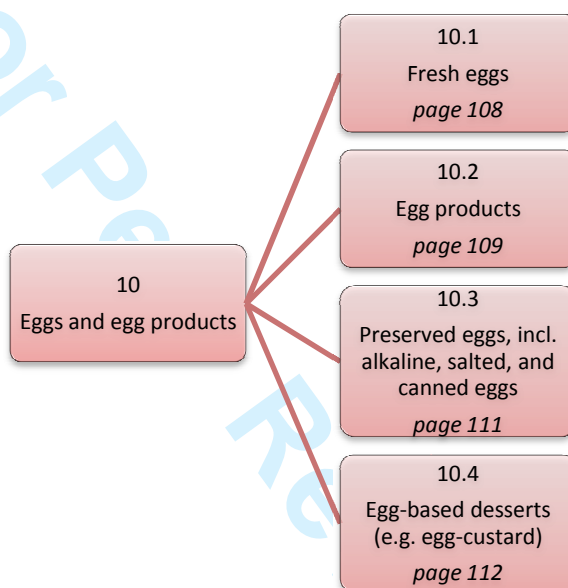
If more details are available for the food items in MG = 10: eggs and egg products, go further with this chapter.

If more details are available for food items with a “MG” = 10, they should be checked for the following characteristics:

- Fresh eggs → 10.1
- Egg products produced from fresh eggs: liquid, frozen or dried → 10.2
- Preserved eggs e.g. salt-cured, alkaline treated → 10.3
- Egg-based dessert → 10.4

If no more details are available: the final code is MG = 10

! If not known fresh eggs or egg product = MG = 10 and SG1 = 1 (fresh) see page 108



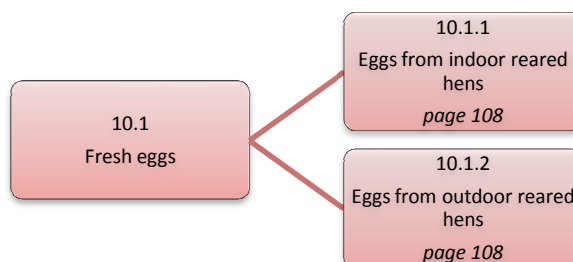
10.1 Fresh eggs:

→ Fresh in-shell eggs are not expected to contain additives. However, colours may be used for decorating, dyeing or stamping the exterior surfaces of shell eggs.

Variable MG = 10
Variable SG1 = 1

If more details are available for food items that meet the definition of “10.1”, they should be checked for the following characteristics:

- If known from indoor reared hens: → 10.1.1
- If known from outdoor reared hens: → 10.1.2



10.1.1 Eggs from indoor reared hens

→ Hens reared in battery cages

Variable MG = 10
Variable SG1 = 1
Variable SG2 = 1

1

Table 1. Food groups used for the classification of food items to assess the exposure to lead, chromium and selenium

MG	Main group
1	Dairy products and analogues (incl. dairy based ices), excluding products of food category "2. Fats and oils, and fat emulsions" e.g. butter
2	Fats, oils and fat emulsions (incl. imitation milks)
3	Edible ices (excl. dairy based ices)
4	Fruits and vegetables (including mushrooms and fungi, roots and tubers, pulses and legumes, and aloe vera), seaweeds, and nuts and seeds
5	Confectionary
6	Cereals and cereal products (cereal grains, tubers, roots, pulses and legumes) (no bakery wares)
7	Bakery wares
8	Meat, meat products, poultry and game
9	Fish, fish products, molluscs, cephalopods, crustaceans and echinoderms (MCCE)
10	Eggs and egg products
11	Sweeteners (incl. honey)
12	Salt, spices, soups, sauces, salads and protein products
13	Foodstuff intended for particular nutritional uses
14	Beverages (excl. dairy products, imitation milks)
15	Ready-to-eat savouries
16	Composite foods
17	Vegetarian meat and fish substitutes
18	Miscellaneous – foods that cannot be placed in categories

2

Table 2. The special codes used for the classification of food items to assess the exposure to lead, chromium and selenium

Special code	Component or physical state
1	Fruit (filling)
2	Nuts/seeds (filling) (incl. coconut)
3	Vegetables (incl. olives)
4	Pulses/legumes
5	Chocolate (filling)
6	Dairy (filling)
71	Powdered form
72	Concentrated form
73	Dissolved from powder or concentrate / Original form
8	No filling / no pieces
91	Fish
92	Molluscs
93	Crustaceans
94	Cephalopods
95	Echinoderm
96	Reptiles: e.g. crocodile, snake
97	Amphibian: e.g. frog
900	Soy
999	Not known

6 Table 3. The communal food groups used in the food categorisation system for lead, chromium and selenium to link food consumption data to occurrence
7 data of these chemicals combined with the percentage of food items per food group for four different countries

Communal food group	Name	Belgium (%); n=1056	Italy (%); n=1530	Sweden (%); n=1548	Czech Republic (%); n=515
1	Composed foods: Cereal based mixed dishes and cereal-based desserts	4.64	0.33	5.56	1.55
2	Vegetables excl. dried vegetables	11.46	4.31	11.95	10.29
3	Nuts and seeds	1.61	1.50	1.03	2.33
4	Coffee and tea in concentrated and in powdered form	0.00	0.39	0.00	1.55
5	Chocolate and chocolate products	3.50	1.44	1.29	2.14
6	Fruit excl. dried fruit	4.92	2.88	6.85	7.38
7	Dried fruit	0.38	0.39	0.39	0.78
8	Fresh and dried herbs, spices, seasonings and condiments	0.00	0.92	0.58	4.47
9	Food supplements	0.00	10.65	4.07	0.00
10	Waters	2.27	9.93	0.32	0.58
11	Sugar, sweeteners and sugar products (e.g. sugar based confectionery, chewing gum and decorations)	1.89	8.04	1.81	2.33
12	Fats, oils and fat emulsions (also e.g. rice milk (no soy milk))	4.92	2.29	2.20	2.52
13	Composed foods: Meat based mixed dishes	0.85	0.13	4.01	0.97
14	Composed foods: Fish based mixed dishes	0.47	0.00	1.29	0.19

15	Dried vegetables	0.00	0.13	0.00	0.39
16	Pulses and legumes	0.76	0.85	1.29	0.78
17	Soy milk and soy based dessert	1.80	0.52	0.13	0.00
18	Milk and dairy drinks	3.69	1.70	1.36	1.36
19	Cheese	3.98	4.58	2.39	3.30
20	Dairy based products	4.64	4.38	4.52	2.33
21	Salt	0.09	0.00	0.06	0.19
22	Fish	2.27	3.40	3.94	5.24
23	Molluscs	0.28	0.26	0.19	0.19
24	Cephalopods	0.00	0.20	0.13	0.00
25	Crustaceans	0.09	0.26	0.78	0.39
26	Other seafood (echinoderms)	0.00	0.07	0.00	0.00
27	Beer and malt beverages	0.38	0.13	0.13	0.39
28	Wine and substitutes	0.19	0.52	0.06	0.78
29	Other alcoholic beverages	0.00	0.26	0.06	1.94
30	Fruit juices and nectars.	1.61	3.99	1.29	0.19
31	Vegetable juices and nectars	0.09	0.00	0.06	0.19
32	Soft drinks and edible ices	3.79	1.76	2.91	1.17

33	Cereals and cereal products (no cereal based desserts or cereal based mixed dishes)	18.84	18.37	15.63	11.07
34	Other food for special dietary uses	0.00	0.26	0.00	0.19
35	Infant formulae, follow up formulae, food for young children and infant formulae and follow up formulae for medical purposes	0.85	3.59	0.90	0.58
37	Miscellaneous foods/products	6.63	2.09	9.17	6.99
38	Liver and kidney	0.47	0.59	0.58	1.94
39	Offals except liver and kidney	0.09	1.44	0.84	2.33
40	Types of vegetarian substitutes for meat and fish	0.66	0.33	0.26	0.19
41	Fresh meat	7.39	2.94	5.49	5.83
42	Processed meat	2.56	2.55	5.68	14.76
44	Coffee and tea in liquid form	1.33	1.11	0.13	0.00
45	Eggs	0.57	0.52	0.65	0.19

8
9 Table 4. Food groups used for the classification of food items to assess the exposure to food colours
10 (exc. lycopene)

Code	Food group name	EXPOCHI*
0	No food colour allowed	X
1	Non-alcoholic flavoured drinks	X
2	Candied fruits & vegetables, Fruit Mustard	X
3	Preserves of red fruits	X
4	Confectionery	X
5	Decorations & coatings	X
6	Fine bakery wares (e.g. viennoiserie, biscuits, cakes, wafers)	X
7	Edible ices	X
8	Flavoured processed cheese	X
9	Desserts inc. flavoured milk products	X
10	Sauces, seasonings (e.g. curry powder, tandoori), pickles, relishes, chutney, piccalilli	X
11	Mustard	X
12	Fish paste and crustacean paste	X
13	Pre-cooked crustaceans	X
14	Salmon substitutes	X
15	Surimi	X
16	Fish roe	X
17	Smoked fish	X
181	Other savoury snack products and savoury peanuts, nuts or hazelnuts	X
182	Snacks: dry, savoury potato, cereal or starch-based snack products: extruded or expanded savoury snack products	X
19	Edible cheese rind and edible casings	X
20	Complete formulae for weight control intended to replace total daily food intake or an	

Code	Food group name	EXPOCHI*
	individual meal	
21	Complete formulae and nutritional supplements for use under medical supervision	
22	Liquid food supplements/dietary integrators	
23	Solid food supplements/dietary integrators	
24	Soups	X
25	Meat and fish analogues based on vegetable proteins	X
26	Spirituous beverages (inc. products less than 15% alcohol by volume), except any mentioned in Schedule 2 or 3	
27	Aromatized wines, aromatized wine-based drinks and aromatized wine-product cocktails as mentioned in Reg 1601/91, except any mentioned in Schedule 2 or 3	
28	Fruit wines (still or sparkling), Cider (except cider bouche) and perry and aromatized fruit wines	
29	Malt bread	X
30	Beer, Cider bouche	
31	Butter (including reduced-fat butter and concentrated butter)	X
32	Margarine, minarine, other fat emulsions, and fats essentially free from water	X
33	Sage Derby cheese	X
34	Ripened Orange, Yellow and broken-white cheese; unflavoured processed cheese	X
35	Red Leicester cheese; Mimolette cheese	X
36	Morbier cheese	X
37	Red marbled cheese	X
38	Vinegar	X
39	Whisky, Whiskey, grain spirit (other than), wine spirit, rum, Brandy, Weinbrand, grape marc, grape marc spirit (other than ...) Grappa invecchiata, Bazaceira velha as mentioned in Reg (EEC) No. 1601/91	
40	Aromatized wine-based drinks (except bitter soda) and aromatized wines as mentioned in Reg (EEC) No. 1601/91	
41	Americano	

Code	Food group name	EXPOCHI*
42	Bitter soda, bitter wine as mentioned in Reg (EEC) No. 1601/91	
43	Liqueur wines and quality liqueur wines produced in specified regions	
44	Vegetables in vinegar, brine or oil (excluding olives)	X
45	Extruded, puffed and/or fruit-flavoured breakfast cereals	X
46	Fruit-flavoured breakfast cereals	X
47	Jams, jellies, and marmalades as mentioned in Directive 79/693/EEC and other similar fruit preparations including low-calorie products	X
48	Sausages, pates and terrines	X
49	Luncheon meat	X
50	Breakfast sausages with a minimum cereal content of 6%; Burger meat with a minimum vegetable and/or cereal content of 4%	X
51	Chorizo sausage; Salchichon	X
52	Sobrasada	X
53	Pasturmas (edible external coating)	X
54	Dried potato granules and flakes	X
55	Processed mushy and garden peas (canned)	X
56	Aperitif wines, spirit drinks including products with less than 15% alcohol by volume	
57	Cocktail cherries and candied cherries	X
58	Bigarreaux cherries in syrup and in cocktails	X
59	Kippers	X
60	External coating of sugar confectionery for the decoration of cakes and pastries	X
61	External coating of confectionery	X
62	Decoration of chocolates	X
63	Liqueurs	
64	Liqueurs, including fortified beverages with less than 15% alcohol by volume	
65	Edible cheese rind	X

Code	Food group name	EXPOCHI*
66	Saucisses de Strasbourg	X
67	All other foodstuffs	X
68	Meat and fish products	X
69	Canned meat products	X
70	Liver pate	X
71	Roast beef	X
72	Meat products (including roast beef, cutlet, ready meals)	X
73	Liquid egg products	X
74	Milk and dairy based drinks	X
75	Fruit and vegetables canned, frozen, etc	X
76	Dairy products	X
77	Noodles	X
78	Ready meals	X
79	Delicatessen salads	X
80	Processed potato products	X
81	Liquid dough	X
82	Milk and cream analogues	X

11 *Food groups that were considered within the EXPOCHI project are marked with the sign "X".

Table 5. Food groups used for the classification of food items to assess the exposure to lycopene

Code	Food group name	Belgium (%) n=1056	Italy (%) n=1530	Sweden (%) n=1548	Czech Republic (%) n=515
0	No lycopene	60.61	69.54	68.73	77.48
19	Non-alcoholic flavoured drinks	3.60	1.70	2.33	1.17
20	Candied fruits and vegetables, Fruit Mustard	0.19	0.20	1.23	0.58
21	Confectionery	0.95	5.88	1.29	1.36
22	Decorations and coatings	0.00	0.00	0.06	0.00
23	Fine bakery wares (e.g. viennoiserie, biscuits, cakes and wafers)	9.19	5.95	6.40	4.47
24	Edible ices	0.19	0.07	0.58	0.00
25	Flavoured processed cheese	0.57	0.52	0.39	0.78
26	Desserts including flavoured milk products	6.34	3.59	5.94	2.33
27	Sauces, seasonings (for example, curry powder, tandoori), pickles, relishes, chutney and picalilli	2.37	0.52	3.75	3.30
28	Jams jellies and marmalades as mentioned in directive 79/693/EC and similar fruit preps	1.42	0.65	1.16	0.78
29	Fish paste and crustacean paste	0.00	0.00	0.06	0.39
30	Pre-cooked crustaceans	0.09	0.07	0.13	0.00
31	Salmon substitutes	0.00	0.00	0.00	0.00
32	Surimi	0.00	0.00	0.00	0.00
33	Fish roe	0.00	0.00	0.13	0.19
34	Smoked fish	0.38	0.07	0.39	0.39
35	Snacks: extruded or expanded savoury snack products	1.33	0.13	0.90	0.97
36	Snacks: other savoury snack products and savoury coated nuts	0.38	0.65	0.26	0.39
37	Edible cheese and edible casings	0.00	0.00	0.00	0.00
38	Complete formulae for weight control intended to replace total daily intake or an	0.00	0.00	0.00	0.00

	individual meal				
39	Complete formulae and nutritional supplements for use under medical supervision	0.00	0.00	0.00	0.00
40	Liquid food supplements / dietary integrators	0.00	0.00	0.00	0.00
41	Solid food supplements / dietary integrators	0.00	0.00	0.00	0.00
42	Meat and fish analogues based on vegetable proteins	0.47	0.33	0.19	0.19
43	Spirituos beverages (excluding products <15% alcohol by volume) except those mentioned in Annex II or III	0.00	0.00	0.00	0.00
44	Aromatized wines, aromatized wine based drinks and aromatized wine product cocktails as mentioned in Regulation (EEC) No 160... except those mentioned in Annex II or III	0.00	0.00	0.00	0.00
45	Fruit wine (still or sparkling); Cider (except cidre bouche) and perry; Aromatized fruit wines	0.00	0.00	0.00	0.00
46	Fruit/vegetable juice-based drinks (including concentrates)	1.61	3.46	1.10	0.39
47	Drinks intended to meet the expenditure of intense muscular effort especially for sportsmen	0.00	0.00	0.00	0.00
49	Breakfast cereals	4.36	2.94	1.42	0.97
50	Fats and dressings	4.83	1.96	1.94	2.52
51	Bread (including crispy breads)	1.14	1.76	1.61	1.36