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Exposure assessment within a Total Diet Study: A comparison of the use of the pan-European classification system FoodEx-1 with national food classification systems

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ABSTRACT

A Total Diet Study (TDS) consists of selecting, collecting and preparing commonly consumed foods purchased at retail level and analysing them for harmful and/or beneficial chemical substances. A food classification system is needed to link food consumption data with the contaminant concentration data obtained in the TDS for the exposure assessment. In this study a comparison was made between the use of a national food classification systems and the use of FoodEx-1, developed and recommended by the European Food Safety Authority (EFSA). The work was performed using data of six European countries: Belgium, Czech Republic, France, The Netherlands, Spain and the UK. For each population, exposure to contaminant A (organic compounds) and/or contaminant B (inorganic compound) was assessed by the Monte Carlo Risk Assessment (MCRA) software using the national classification system and FoodEx-1 for food consumption data and for TDS laboratory results. Minimal differences between both approaches were observed. This observation applied for both contaminant A and contaminant B. In general risk assessment will be similar for both approaches; however, this is not guaranteed. FoodEx-1 proved to be a valuable hierarchic classification system in order to harmonise exposure assessment based on existing TDS results throughout Europe.

1. Introduction

A Total Diet Study (TDS) consists of selecting, collecting and analysing commonly consumed food purchased at retail level, processing the food as for consumption, pooling the prepared food items into representative food groups, homogenising the pooled samples and analysing them for harmful and/or beneficial chemical substances (EFSA, FAO, & WHO, 2011). TDSs are commonly designed at national level and aim to cover the overall diet of the population, in order to assess the dietary exposure to the chemical substances of interests by the population of a certain country. To know which foods contribute the most to the diet of the population of interest and therefore need to be analysed in the TDS, existing consumption data at national level are used (Devlin et al., 2014a, 2014b). Once the analytical data on the chemical substances of interests are available, a dietary exposure assessment is performed in order to determine

Abbreviations: CCPR, classification developed by Codex Committee on Pesticide Residue; CIAA, Confédération des Industries Agro-Alimentaires (Confederation of the Food and Drink Industries in the EEC); DNFCS, Dutch National Food Consumption Survey; EFSA, European Food Safety Agency; ENIDE, 'Encuesta Nacional de Ingesta Dietética' – National Survey of Dietary Intake; INCA, French Individual National Food Consumption Survey; LB, lower bound; LNN, Logistic Normal Normal; MCRA, Monte Carlo Risk Assessment; NDNS, National Diet and Nutrition Survey; PROCOME, Eurostat Food Coding System for Household Budget surveys; RIKILT, Dutch Institute for Food Safety; RIVM, National Institute for Public Health and the Environment of The Netherlands; SSD PARAM, Standard Sample Description Parameter code; TDS, Total Diet Study; TRV, toxicological reference value; UK, United Kingdom.

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whether specific food chemical substances pose a risk to the public health, i.e. whether the intake of these substances is higher than a toxicological limit. To perform such an exposure assessment, a food classification system is needed to link existing food consumption data with the analytical data (occurrence data) obtained in the TDS. In Europe, there is a need to develop a harmonised TDS approach as currently each European country has its own approach, making it difficult to compare results. Harmonisation of a TDS between countries includes a harmonised exposure assessment. Therefore, it is of interest to strive towards a feasible harmonised food classification system. The importance of food classification and description systems has been generally acknowledged within food safety research (Ireland and Møller, 2000). The preparation of reliable data on food requires accurate identification of foods. National or regional classification systems have often a long history and are specific to the respective nation or region. Generally, national or regional classification systems are purpose specific, and are not compatible with other systems (EFSA, 2010a). Therefore, regional and national classifications are useful to outline the specific food consumption patterns, while it is necessary to match these to international classification in order to make comparison on an international level.

Striving towards a harmonised system of categorisation at pan-European level to link food consumption and occurrence data, in order to assess the exposure to chemicals present in food, is not a novel goal. In the past, two methods have been used to identify foods: classifying foods in universal categories or adding food description to foods in a database (EFSA, 2011b). A variety of food classification systems have been developed, each with different objectives. All food classification systems are designed for a specific purpose, which is both a strength and a weakness (Ireland and Møller, 2000). A classification system is designed not only for a given purpose, but also with a particular level (food versus ingredient) on which the foods are classified. Whereas most national classification systems are based on intake level (foods as consumed), some international systems are based on ingredient level and others on commodity level (EFSA, 2011b). For example, the CIAA (Confederation of the Food and Drink Industries in the EEC) system is an additive driven system (CIAA, 2014), while PRODCOME (Eurostat Food Coding System) is a food classification system used for household budget surveys (EC, 2014) and the CCPR Classification of Food and Animal Feed (classification developed by Codex Committee on Pesticide Residue) is a residue and contaminant driven system (CCPR, 2014; Ireland and Møller, 2000).

Efforts were made to develop approaches to identify foods in databases by food description systems using internal codes and description. The two major examples are the LanguaL thesaurus (LanguaL, 2014) and the INFOODS system. LanguaL uses well-defined terms, while INFOODS is a system using free text dependent on national language (Ireland and Møller, 2000). LanguaL is a multilingual thesaural system using faceted classification, including main food coding system. INFOODS is a food component system, aimed at managing food information, including the standardisation of food component names (FAO, 2014). It requires specific guidelines on food matching (FAO, 2012). Existing food description and classification systems present several drawbacks when assessing exposure to different hazardous chemicals (EFSA, 2011a), i.e. LanguaL allows for accurate description of foods but cannot identify a food that is included in a list/group of foods. Therefore, in 2008 EFSA decided to tackle this issue by developing a new system called FoodEx (referred to in this article as FoodEx-1). This system was developed by the Data Collection and Exposure Unit (DATEX) of EFSA. The main objective of FoodEx-1 was to facilitate the assessment of dietary exposure to hazardous chemicals by allowing accurate matching of the chemical occurrence and food consumption datasets at pan-European level (EFSA, 2011a). FoodEx-1 builds on different food description and classification systems with consideration of legislative requirements (EFSA, 2011a). Different food descriptions and classification systems were precursors of FoodEx-1, such as the European Food Informative Resource (EuroFIR) and the Co-operation in Science and Technology (COST 99), Eurocode-2 (Poortvliet and Kohlmeier, 1993) and the European Food Groups (EFG) systems (Ireland et al., 2002). The legislative requirements considered in the development of FoodEx-1 were provided by Commission Regulation (EC) 1881/2006 on setting maximum levels for certain contaminants in foodstuffs and Commission Regulation (EC) 396/2005 on the maximum residue levels of pesticides in or on food and feed of plant and animal origin.

However, despite the many challenges, EFSA's scientific Colloquium on 'Food Classification: Unambiguous ambiguity' agreed that a multi-faceted system that would enable end-users to analyse the data from various perspectives would be an important improvement (EFSA, 2011a).

The use of FoodEx-1 was thoroughly evaluated in 2011. This highlighted the importance of having a system including facets, which are detailed descriptors also used in the EPIC-soft system (EFSA, 2011a). EPIC-soft is a software program used by different countries for their dietary surveys (Slimani and Valsta, 2002), e.g. Belgium, Germany, France and The Netherlands. This program uses facets and descriptors to describe foods and beverages. Facets proved to be necessary when assigning FoodEx-1 codes and together with food description systems, such as LanguaL, are the basis for further improvement and refinement of FoodEx-1 (EFSA, 2011a). Therefore improved FoodEx-2 classification and descriptive system has been developed and launched by EFSA in 2013. In this study, existing TDS data were used, which were already coded in FoodEx-1 system, therefore FoodEx-2 was not used in this work.

Although FoodEx-1 has had an intensive and profound preamble, on the basis of exposure assessment the need to overview food linking systems and compare their influence on the exposure assessment is still topical. To assess the feasibility of harmonisation of food categorisation on a pan-European level and to use such a harmonised system for exposure assessment using TDS analytical results, it is our aim to compare the exposure assessments obtained when applying national food categorisation systems and the FoodEx-1 system. If exposure assessments based on national systems are comparable with the FoodEx-1 estimates of exposure, FoodEx-1 could be a good food classification system to use at the pan-European level.

In this study, different contaminants were used for this exercise, specifically a group of organic compounds and a metal: contaminant A and contaminant B. Consumption data as well as TDS concentration data for six different countries were used: Belgium, Czech Republic, France, The Netherlands, Spain and the UK.

2. Materials and methods

In order to compare the impact of applying a national and an international food coding system (FoodEx1) in six countries (Belgium – BE, Czech Republic – CZ, France – FR, The Netherlands – NL, Spain – ES, United Kingdom – UK), two compounds with different exposure patterns – one organic (A) and one inorganic (B) – have been selected to take into account the diversity in formulating the food lists as the potential food source differs between the two contaminants. Exposure assessment was done by linking the national food consumption data to the concentration data obtained in each national TDS in two different ways (national systems versus harmonised FoodEx-1 system).

The 50th, 95th and 99th percentiles of exposure were estimated for each compound per country and per categorisation system, and the top three of food items contributing to the exposure was identified. The actual modelling of long-term exposure to contaminant A and contaminant B was carried out using MCRA 8.0 (de Boer et al., 2013).

2.1. Consumption surveys

Preference was given to national consumption surveys, presenting data representative for the whole country. A recording of consumption data during at least two days per individual was required to perform long-term exposure assessments