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Methodology for rendering household budget and individual nutrition surveys comparable, at the level of the dietary information collected

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Abstract

Objective: To describe the methodology applied in order to render comparable, at the level of the dietary information collected, the household budget survey (HBS) and individual nutrition survey (INS) data from four European countries (Belgium, Greece, Norway and the United Kingdom).

Setting: In Belgium, data from the HBS of 1987–88 were compared with data from the Belgian Interuniversity Research on Nutrition and Health collected from 1980 to 1985. In Greece, data from the HBS undertaken in 1993–94 in the greater Athens area were compared with data collected around 1994 in the same region, in the context of the Greek segment of the European Prospective Investigation on Cancer and Nutrition study. In Norway, data from the HBS carried out in 1992, 1993 and 1994 were compared with the NORKOST study conducted in 1993–94. In the United Kingdom, data from four HBSs carried out in 1985, 1986, 1987 and 1988 were compared with the National Dietary and Nutritional Survey of British adults conducted in 1987–88.

Design: INS-generated data were converted into 'HBS-like' estimates with the application of yield factors for weight changes during cooking, recipe-based calculations and edible proportion coefficients taking into account weight changes during the food preparation. The 'HBS-like' estimates thus obtained were compared with the original HBS values, after applying an adjustment factor for food spoiled or given to pets.

Conclusion: The methodological considerations overviewed in the present paper indicate that a number of issues need to be taken into account before a proper comparison of the dietary data collected through surveys implemented with varied methodologies is carried out.

Keywords
DAFNE
Household budget surveys
Individual nutrition surveys
Comparability

Documenting and monitoring dietary patterns are among the prime contributions of nutritional sciences in the development of nutritional epidemiology, the formulation of dietary recommendations and the planning of national food, nutrition and agricultural policies. Diet represents an unusually complex set of exposures that are strongly intercorrelated. Early efforts have been focused on identifying the specific nutrients that may be responsible for effects on people's health. Current data, however, suggest that apparently favourable effects cannot be exclusively attributed to specific components and in several instances these components may act synergistically. Consequently, instead of focusing only on nutrients within foods, research has expanded towards studying patterns of food intake[1–3].

International comparisons of dietary exposures are usually based on food rather than nutrient intake, since the lack of compatibility of food composition data from various countries[4] may compromise the validity of the observed relationships. The food data used for international comparisons are often derived from: (1) food balance sheets (FBSs), assembled by the Food and Agriculture Organisation (FAO), which provide information on food supply at the population level[5]; (2) household budget surveys (HBSs), which collect data on food availability in the household, based on nationally representative samples of households[6]; and (3) specifically designed individual nutrition surveys (INSs), providing information on the food intake of free-living individuals, over a specified time period[7].

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The FBS data are useful when conducting comparisons of the adequacy of food supply and for following crude dietary changes over time. The individual surveys, when intakes of the subject are recorded as adequately as possible, are expected to provide evidence on the food quantities consumed. Nevertheless, when international comparisons are undertaken, the differences in study design and analysis of the various surveys reduce the comparability of the results and, eventually, their usefulness[8].

The potential of using HBS data for international comparisons on food availability is currently being investigated through the DAta Food NEtworking (DAFNE) initiative that involves 14 European countries. The early results of this project have shown that it is possible to harmonise food data collected in the national HBS and thus generate comparable inter-country information on food availability at the household level. These data could become very useful for public health, agricultural and economic purposes[9,10].

While the DAFNE initiative has been successful in maximising comparability of HBS data between countries, a need developed to investigate these data through comparisons with INS-generated information. An EU-supported project, entitled 'Compatibility of household and individual nutrition surveys and disparities in food habits', was initiated. Its aim was to study individual HBS data from four European countries (Belgium, Greece, Norway and the United Kingdom) in comparison with food consumption values derived from the INS and subsequently transformed with the application of adjustment factors. From the public health perspective, the objective was to evaluate whether HBS and INS can converge, given the limitations and inconsistencies present in both approaches, in order to describe the dietary habits of the studied populations.

The present paper describes the methodology applied in order to render the HBS and INS datasets comparable, at the level of the dietary information collected. The methodology used was based on *a priori* considerations, discussed in workshops of participants from the four countries, and did not involve (at this stage) empirical assessment of comparability.

Surveys included in the analysis

In Belgium, HBS data collected in 1987–88 were compared with data collected in the Belgian Interuniversity Research on Nutrition and Health (BIRNH). The BIRNH study was carried out from 1980 to 1985 on a large representative sample of the Belgian population (n = 11 302), aged from 25 to 74 years[11]. The dietary assessments included a 24-hour recall combined with a food-frequency questionnaire. The information recorded on food intake has been disaggregated into 184 raw food items, using recipe calculation data and specific preselected conversion factors.

In Greece, HBS data collected in 1993–94 in the greater Athens area were compared with data collected around 1994 in the same region, in the context of the Greek segment of the European Prospective Investigation on Cancer and Nutrition (EPIC). The EPIC study is a large prospective cohort study set up to explore the role of nutrition in the aetiology of cancer and other chronic diseases. The study has been carried out continuously since 1994 and approximately 28 000 subjects aged 25–86 years were recruited[12]. From the dietary point of view, the baseline data collection included an interviewer-administered semi-quantitative food-frequency questionnaire, covering the subject's food, alcohol and dietary supplement intakes during the previous year. The food items and beverages included in the questionnaire were quantified using food portion photographs, household and natural units or standard portions. Specific questions were asked to identify individuals following a special diet and to capture seasonal variability in food consumption. The EPIC dataset used in the present analysis included information on the food intake of 5478 residents of private households in the greater Athens area, aged 27–82 years. The food information was referring to 50 simple foods, 159 mixed dishes and recipes and 15 alcoholic and non-alcoholic beverages.

In Norway, data from the household budget surveys carried out in 1992, 1993 and 1994 were compared with the NORKOST study conducted in 1993–94. The NORKOST was a nation-wide survey of a representative random sample of the adult Norwegian population and was undertaken by the National Nutrition Council[13] in collaboration with the National Food Authority, Institute for Nutrition Research and the Norwegian Statistical Office. Approximately five thousand (n = 5008) subjects were recruited and 3144 questionnaires were found adequately completed. A self-administered, quantitative food-frequency questionnaire (QFFQ) was used for the data collection. The QFFQ was designed to cover the whole diet including approximately 180 food items, grouped according to the Norwegian meal pattern. The selection of foods, portion sizes (standard portions and household units) and frequencies was based on experience gained from earlier dietary surveys.

In the United Kingdom, data from four household budget surveys carried out in 1985, 1986, 1987 and 1988 were compared with the National Dietary and Nutritional Survey (NDNS) of British adults conducted in 1987–88 by the Social Survey Division of the Office Population Census and Surveys (OPCS). A nationally representative sample of 2197 adults, 16–64 years old, living in private households, was recruited in the NDNS survey[14]. Pregnant women and those for whom dietary and physiological status could, for various reasons, be impaired were excluded from the survey. In terms of dietary information,

each participant provided a weighed dietary record of everything consumed during 4 to 7 days, including dietary supplements and medicines. Since participants were asked to openly record everything consumed during the recording period, the NDNS dataset includes approximately 5000 food codes referring to simple foods, recipes and mixed dishes. Foods eaten away from home were identified in the survey, but the source of the food (household supply, canteen or restaurant) was not.

Methodology

Household budget surveys refer to the beginning of the dietary chain (purchased food items brought into the household), while individual nutrition surveys refer to the end of it (food prepared, cooked and consumed). The approach that was followed aimed at converting the INS consumed food quantities into 'HBS-like' estimates and comparing the latter with the original HBS values. We thought of going 'backwards' from INS to HBS, rather than the other way around, in order to bypass the inherent uncertainties in the process of individualisation.

It is common practice in dietary analyses to estimate raw edible foods and ingredients from the corresponding food consumption data. The opposite procedure – that is, trying to estimate, from HBS data on foods purchased, how much was consumed raw and how much was eaten after being cooked according to different cooking procedures – has apparently not been attempted.

The methodology used can be summarised in Figs 1 and 2. The figures present the approach for converting INS data into 'HBS-like' data, depending on whether INS records refer to a simple cooked food (Fig. 1) or a mixed dish/recipe (Fig. 2). In both instances, the aim is to estimate the weight of the corresponding raw food by applying either simple yield factors (simple foods) or recipe-based calculation factors (mixed dishes/recipes). After estimation of the weight of raw foods and ingredients, the last step is common in both figures and refers to the application of edible proportion factors, taking into account weight changes during food preparation.

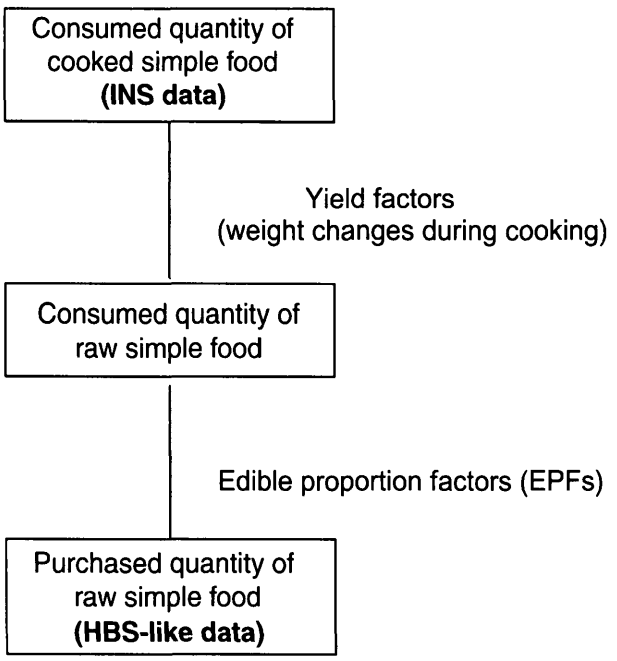

Fig. 1 Conversion of the consumed quantity of simple foods into purchased quantity

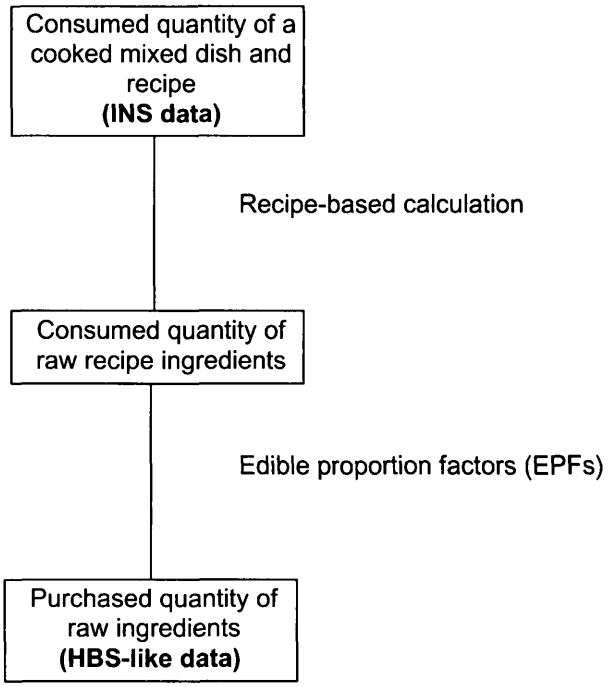

Fig. 2 Conversion of the consumed quantity of mixed dishes and recipes into the purchased quantity of their ingredients

Weight changes during cooking

Yield factors can be applied to simple foods to allow for weight changes during cooking due to changes in the water and/or fat content of the food item. Yield factors are highly dependent on the state and the amount of the food to be cooked[15]. Thus different factors may be found for the same food item, depending on the selection of standard weight and on whether assessments are made on the basis of edible ingredients. Nevertheless, most systems have 100 g as standard weight and estimate the yield factor by taking into account the edible proportion.

Yield factors to convert from cooked to raw weight were applied to simple foods recorded in the NDNS survey of British adults. *McCance & Widdowson's Food Composition Tables*, 5th edition[16], was used as the source of the factors applied. In cases where no factors were available, these were estimated on the basis of the protein content of the food as served, since the protein content does not change during the cooking procedure[17].

The information on all cooked items available in the Greek EPIC dataset was referring to either mixed dishes or recipes. Hence, recipe-based calculations were regularly applied.

Recipe-based calculations

Recipe calculations need to be applied for disaggregating mixed dishes (e.g. a salad, fried potatoes) and recipes into their raw ingredients. They are of particular importance for nutrient estimations of food consumption studies, where subjects often report dishes that do not appear in the standard food composition table or where the reported dish differs significantly from the one presented in the table.

In the present analysis, national recipe books were reviewed and appropriate recipes were selected. The selection criteria, which were based on internationally applied ones[18], were the following:

1. The selected recipe had to closely reflect the food preferences of the studied population.
2. Quantitative information on the raw recipe ingredients had to be available, together with specific information on whether the weights of the raw ingredients were assessed with or without their inedible part.
3. An adequate description was necessary of how these ingredients are combined.
4. The weight of the dish in the 'ready to serve' condition had to be available.

In the analysis of the Greek EPIC dataset, information on 102 recipes and 57 mixed dishes was retrieved from *The Book of Standard Greek Recipes*[19]. For the British data, information on 800 recipes (600 from McCance & Widdowson and 200 from data supplied by the British Ministry of Agriculture, Fisheries and Food (MAFF)) was used. In all instances, recipe-based calculations allowed estimation of the weight of raw ingredients that was required for preparation of the consumed dish.

Since information on the food source (household, restaurant or industry) was not always available in the individual dietary surveys, all dishes were analysed on the basis of standard national recipes.

The edible food matter

Individual nutrition survey data include information on the quantity of food consumed. Thus, edible proportion factors (EPFs) need to be taken into consideration in order to estimate the weight of the purchased food from which the consumed item was derived.

Edible proportion factors are relevant to the following food groups:

- *potatoes and vegetables* – inedible matter is removed during preparation procedures, such as peeling or removing tough parts, outer leaves or stalks, before the food is put in the casserole;
- *fruit and nuts* – similar is the case for fruit and nuts, where the inedible matter usually refers to nut shells, pips, stones and core, parts that are generally not consumed;
- *meat and the fish and seafood group* – the case of meat, fish and sea products is different, however, since removal of the inedible food matter may take place partly during food preparation (removal of rind, fatty parts and other handling losses) and partly during consumption (removal of the bone).

The way bone is handled in the INS datasets is not consistent and depends on the kind of fish or meat cut. In many cases, handling of the recorded data always implies the application of EPFs in order to estimate the food quantity 'actually consumed'. This, however, is not always the case and in order to be able to analyse, compare and interpret consumption data, explicit knowledge of the nature of the data is necessary.

In cases where the application of yield factors (Fig. 1) and recipe-based data (Fig. 2) provides the weight of the raw food item that includes the bone, the finally applied EPF to convert to the purchased food should refer only to the remaining preparation losses (e.g. rind and fatty parts). Nevertheless, factors providing this specific information are generally not available in the literature.

The EPFs that are commonly available always include the bone and can be thought of as derived from the following ratios.

When the reference item is raw:

$$\text{Edible Proportion Factor (EPF)} = \frac{\text{Weight of the raw edible matter}}{\text{Weight of the purchased food item}} \quad (1)$$

When the reference item is cooked:

$$\text{Edible Proportion Factor (EPF)} = \frac{\text{Weight of the cooked edible matter}}{\text{Weight of the cooked item, as this is served in the dish}} \quad (2)$$

For the purpose of our analyses, EPFs were applied in the case of fish and meat cuts only when the quantity consumed did not include the bone. In any other case, no factor was applied. Since the proportion of preparation losses, if any, is substantially lower than the proportion referring to the bone, a small underestimation was considered preferable to double-counting the bone.

In order to accomplish a uniform approach by all countries, the EPFs from *McCance & Widdowson's Food Composition Tables (Supplements)* were applied. The use of the same source of EPFs was considered acceptable, since the within-country variation in the proportion of food edible matter is probably larger than the inter-country variation.

Food wastage and spoilage

A proportion of the purchased food is wasted, spoiled or given to pets, and this issue also needs to be considered.

Relatively recent information on the proportion of food wasted is limited[20]. All attempts to record food wastage showed that it is difficult to estimate the amount of food thrown away by any given household. Surveys also vary on what they define and record as food waste. In some cases all food discarded (inedible matter, spoiled food, food given to pets or simply food that was not consumed) is recorded, whereas in other cases attention is limited on some of the above. The subject effect is quite strong when people are asked to report their domestic food waste. They feel self-conscious and embarrassed, assuming that their behaviour is being assessed and may be criticised. It is also worth mentioning that there is no clear evidence as to whether the reported food waste is increased or reduced because of the recording effect, since some households apologise for not having left more waste and others for there being so much[21]. All surveys, however, seem to agree that the leftovers are usually plate waste, meat fat and trimmings, bread and other cereals and milk. Seasonal variation was also observed, with the total quantity of food discarded being higher in summer than in winter. The domestic wastage was found to be markedly dependent upon the composition of the family as well. Dowler[22] reported that plate waste often came from a child's plate and Wenlock *et al.*[23] noted that although the first child was the main contributor to the food waste, with each additional child the effect became less evident. In the case of households keeping pets, considerable quantities of food can be diverted to animals, but it is not possible to ascertain what proportion of the food given has been purchased for this specific purpose.

Taking into account the amount of food wasted is a difficult task. MAFF, which is responsible for the longest run series of household budget surveys, applies a factor of 10% in HBS estimates to allow for wastage of edible food[24]. In the present analysis, the same factor of 10% household waste was applied to all food items recorded in all HBSs.

Exclusion of subjects

It is common practice, when analysing food consumption data, to repeat analyses after identifying and excluding the underreporters. Underreporting can arise by a simple failure to report or record everything eaten, either consciously or subconsciously or by a modification of usual eating habits towards those that are generally considered to be healthy (e.g. consumption of fruit and vegetables).

If poor compliance in assessing food intake were related exclusively with specific variables (overweight, diet of poor quality, low socio-economic status, alcohol consumption or smoking), the bias that could possibly be introduced would be controlled. However, it seems that the nature of poor compliance is much more complicated[25]. More problematic is the interpretation of results that are suspiciously but not unbelievably low.

There is also no clear indication as to which components of the diet are usually underreported. Available evidence suggests that lipids and sucrose are not appropriately reported and subjects have named recording snacks as the most disturbing aspect of the procedure[26]. Men tend to underestimate their alcohol consumption, whereas women are prone to underreporting in general.

Finally, there is a possibility that subjects who are unwell or who report dieting to lose weight during the survey period may be reporting a low food intake. In theory, those who are unwell or dieting may actually consume less. The expectation is that this would be reflected in their food purchases.

In the present analysis, misreporters, unwell persons and self-declared dieters were not excluded. This choice is based on the assumption that the presence of conscious and subconscious underreporters, as well as of people altering their usual intake for various reasons, is equally frequent among households recorded in the HBS and individuals of the INS. Although underreporters can be excluded from INS data[27,28], such exclusions cannot be considered in the HBS data since the protocol of these surveys does not allow for the identification of such bias.

Conclusion

In an attempt to follow up trends in food consumption, dietary data collected through the FAO-assembled food balance sheets, household budget surveys and individual nutrition surveys are usually retrieved and directly compared. Authors comment on the different nature of the data when interpreting the differences observed. Although rough comparisons of dietary patterns can be undertaken, the methodological considerations overviewed indicate that a number of issues need to be taken into account before a proper comparison of the dietary data collected in the various surveys is carried out.

The presented work has also revealed that conversion factors, currently available in the literature, are not always similar in different countries. Comparability could be achieved if information on how these factors were estimated was systematically provided in all tables or if a common approach for their estimation was decided and applied in all instances. The provision of information on how the factors were estimated or the development of a common approach for their estimation substantially contributes to improvement in the comparability of data from different countries.

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