

Food composition—essential data in epidemiological studies of food and health

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Introduction

Food composition data are an essential component of many food-health studies, including epidemiological studies. Food composition may change over time and so national food composition tables are updated periodically. The reasons for food composition variation described in this paper indicate that quantitative comparisons of nutrient intake over time, or between countries at one time, need to be made cautiously.

Food Standards Australia New Zealand (FSANZ) analyses foods for regulatory purposes, maintains Australian national food composition tables and has compiled food composition tables for national nutrition surveys (NNS). These tables and their underlying data have been released and are used by researchers, consumers, industry and others.^{1,2}

Prior to the 1980s, Australian food composition tables were based largely on overseas data.³ Extensive analysis during the mid-1980s of a range of foods by university researchers⁴ and the Commonwealth of Australia lead to the *Composition of Foods Australia* and then to the first Australian electronic tables.⁵ These data formed the basis to analyse nutrient intakes for the 1995 Australian NNS. New composition data have been compiled from various surveys.

The Australian Total Diet Study

The Australian Total Diet Studies (ATDS) (previously called 'market basket' surveys) have been carried out in Australia since 1970. Initially, the dietary exposure to pesticide residues, additives and contaminants in food, including metal nutrients such as zinc, copper and selenium, were estimated. In 2003, the scope of the ATDS expanded and was included on the Implementation Sub-Committee's Coordinated Food Survey Plan which was developed to enhance collaborations, efficiencies and quality of national or bi-national food surveys.

The foods sampled in an ATDS vary depending on the focus of the survey but are broadly representative of the major foods consumed in Australia. Samples are collected from all states and territories and are prepared to a 'table-ready' state before analysis. In the 22nd ATDS, for example, 740 composite samples of 96 types of food were analysed for iodine, selenium, chromium, molybdenum and nickel. The composition data were applied to the food intakes reported in the 1995 NNS to estimate both the mean and range of dietary intake of the minerals for various population groups.⁶

The Key Foods Program

The 2007 Australian Children's Nutrition and Physical Activity Survey was the first Australian NNS in 12 years and FSANZ was contracted to develop the food composition database to code the food intake data. Because food composition analysis is expensive and funding is limited, FSANZ modified the 'Key Foods' approach developed by the United States Department of Agriculture to prioritise analyses.⁷ The major food sources of various nutrients for Australian children aged 2–15 years were identified from the 1995 NNS and foods were ranked by their overall contribution to intake of all nutrients assessed. The top ranking foods were selected for analysis, with some moderation of foods to reflect any recent analyses or likely shifts in consumption since 1995 (for example, increasing consumption of reduced fat milk). The national sampling strategy included capital cities and some regional centres. Some food samples were analysed individually (where a food was a top tertile contributor to intake of a nutrient) and provide information on variation in nutrient levels. Sampling was conducted in 2006.

In 2008 FSANZ commissioned a second program, focussing on foods that contribute to nutrient intakes for Australians aged 16 years and over. Because a number of these foods had been analysed in 2006, not all top-ranked foods were analysed, thus allowing some resources to be devoted to new products, fortified foods and foods likely to have changed in composition. Samples were collected in both summer and winter.

Other food composition surveys

FSANZ sometimes conducts special purpose surveys, often in conjunction with other government agencies. For example, following a recent multi-agency survey of trans fatty acid levels in packaged and takeaway foods, FSANZ organised sodium and iodine analysis on the same foods.^{8,9} In 2005, FSANZ conducted surveys focussing on those foods that are major contributors to iodine and folic acid intake, to support consideration of the need for mandatory fortification with these nutrients.

Changing composition data

Food composition data can change over time because the methods of analysis or presentation format changes or because the foods themselves have changed. Consequently, caution is needed before adopting overseas food composition data into local tables.

Analytical improvements

As analytical methods develop, lower concentrations or a greater range of compounds might become detectable. Folates in foods are now usually measured using a triple enzyme extraction technique. Much of the folate data published in the 1990s used a single enzyme extraction, which may give lower values for some food types, even when there has been no substantial change in the food.¹⁰

Some nutrients continue to present analytical challenges. Vitamin D is an example of this, where the very low levels and different chemical forms found in unfortified foods may not be able to be quantified with acceptable certainty.¹¹

Analytical differences

Several different analytical methods might exist for a nutrient at one time. For example, different methods for fibre identify the various sub-components to different extents. The Australian food composition tables give fibre values measured using the Association of Official Analytical Chemists (AOAC) Total Dietary Fibre method specified in Standard 1.2.8 of the Australia New Zealand Food Standards Code (Food Standards Code).¹² Food tables in other countries, such as New Zealand, might report different fibre values for the same food because a different analytical method has been used.

Variation in expression

Levels of some nutrients are not measured directly but are calculated from other components, sometimes with the use of activity factors. NUTTAB 2006 expresses folate as dietary folate equivalents (natural folate +[1.67xfolic acid]); in contrast, AUSNUT 1999 reported total folates as the sum of these two components.^{1,13} Users should read accompanying notes to check for methods of expression for the data they wish to use.

Changing food supply

The emergence of new foods might be quite obvious, for example, flavoured water with added vitamins is a new entry in AUSNUT 2007 compared to AUSNUT 1999.¹³ Other changes might be less obvious to data users. For example, what the average consumer may call 'margarine' is actually 'edible oil spread'. Although a true margarine must contain at least 80% fat (Food Standards Code, Standard 2.4.2¹⁴), almost all spreads now available contain 70% or less fat without being labelled as 'reduced fat'. This has implications when assigning food codes to, for example, a food frequency questionnaire that might be administered several times during a cohort study. Replacement of data for margarine with data for spread might substantially alter estimated intake of unsaturated fat.

There may be deliberate changes in food composition due to government mandate (e.g. fortification with folic acid and iodine) or specific initiatives by non-government or other organisations. New fruit and vegetable varieties may be

developed that sometimes have important nutritional differences (such as higher sugar levels or colour differences due to changing carotene levels). These changes affect not only the specific foods themselves, but also the "not further specified" code that is used in surveys when respondents are unable to describe all aspects of the food eaten.

Variability and uncertainty in the composition of foods

Just as humans vary in height, weight and serum cholesterol levels, so too do foods vary in their composition. Variability in nutrient levels results from a number of factors including season, species, soil type, formulation (for processed foods) and food samples selected for analysis might not capture the overall variability in nutrient levels.¹⁴ Analytical methods also have associated uncertainty. Data reported in food composition tables are therefore 'best estimates' of nutrient levels and are only a representation of the 'true' nutrient value for that food.

In FSANZ's Key Foods Program, samples of foods that make major contributions to intake of a nutrient were analysed separately so that the variability in levels of that nutrient could be described. A composite of many samples was analysed if a food was a lesser contributor, to maximise the efficiency of the limited funding available. Values determined on composite samples can be considered as average values but provide no information on variability. Milk is a major source of iodine and calcium in Australian diets. Table 1 illustrates the extent of their innate variation around the mean values reported in food tables.

Table 1: Iodine and calcium values in full fat milk purchased in Australia in 2006 and 2008¹⁵

Milk, regular fat (3%)	Iodine (µg/kg) Mean (range)	Calcium (mg/kg) Mean (range)
2006 (n=20)	230 (150 – 310)	1030 (950 – 1200)
2008 (n=16)	230 (70 – 450)	1040 (790 – 1290)

n = number of purchases

Implications for researchers

In short-term studies, it is evident that the most current nutrient data should be used. When AUSNUT 2007 was released, FSANZ recognised that this was the first new compiled complete dataset in a decade and some researchers might have coded recent data using AUSNUT 1999. Therefore, a file matching the codes between the two databases was released to assist those wishing to update the coding in their studies.¹⁶ This is not a complete solution because researchers still need to consider how they have coded foods which might have changed over time.

In randomised controlled trials, changing food composition might be unimportant if the sole purpose of describing nutrient intake is to show comparability between intervention and control groups. If the goal is to compare recent intake to biomarkers that respond quickly to dietary changes, the variation among samples of the same food might dilute the expected relationship so profoundly that researchers should consider calculating nutrient intakes from duplicate portion analysis rather than average composition data from tables.

The decision about whether to recode food intake data for longer term studies is complex, especially if food intake data has been collected several times. If compositional differences are due to better analysis, then one can argue that new data should be applied backwards in time. If technical improvements coincide with real change in the food supply then it is more difficult. It may be possible to identify indicator foods and conduct sensitivity or 'bridging' analyses to examine the impact of various assumptions on relative risk estimates. Similar considerations apply when doing sequential cross-sectional analyses of population intakes because failing to understand the composition data might lead to erroneous conclusions about trends.¹⁷

Disclaimer

The views are those expressed by the authors and not necessarily those of Food Standards Australia New Zealand.

References

1. **Food Standards Australia New Zealand.** NUTTAB 2006 – Australian Food Composition Tables. Canberra: FSANZ, 2007. Available from <http://www.foodstandards.gov.au/monitoringandsurveillance/nuttab2006/index.cfm> (accessed 9th February, 2010)
2. **Food Standards Australia New Zealand.** AUSNUT 2007 – Australian Food, Supplement and Nutrient Database for Estimation of Population Nutrient Intakes. Canberra: FSANZ, 2008. Available from: <http://www.foodstandards.gov.au/consumerinformation/ausnut2007/> (accessed 9th February, 2010)
3. **Thomas S, Corden M.** Metric tables of composition of Australian foods. Canberra : Australian Govt. Publishing Service, 1977.
4. **Greenfield H, Wills RBH.** A bibliography of UNSW studies on the composition of Australian foods and related areas. *Food Technol Aust* 1985; 37(10): 460-461.
5. **English R.** Composition of foods, Australia. *Food Australia* 1990; 42(8): S5-S7.
6. **Food Standards Australia New Zealand.** The 22nd Australian Total Diet Study. Canberra: FSANZ, 2008. Available from http://www.foodstandards.gov.au/_srcfiles/ATDS.pdf (accessed 9th February, 2010)
7. **Haytowitz DB, Pehrson PR, Holden JM.** The National Food and Nutrient Analysis Program: A decade of progress. *Journal of Food Composition and Analysis* 2008; 21: S94– S102.
8. **Food Standards Australia New Zealand.** Intakes of trans fatty acids in New Zealand and Australia. Canberra: FSANZ, 2010. Available from http://www.foodstandards.gov.au/_srcfiles/TFA_intakes_2009.pdf (accessed 9th February, 2010)
9. **Food Standards Australia New Zealand.** Sodium levels in a range of packaged and take-away foods. Canberra: FSANZ, 2010. Available from <http://www.foodstandards.gov.au/scienceandeducation/publications/sodiumlevelsinarange4648.cfm> (accessed 9th February, 2010)
10. **Tamura T, Mizuno Y, Johnston K, Jacob R.** Food folate assay with protease, alpha amylase and folate conjugase treatments. *J Agric Food Chem* 1997; 45: 135-139.
11. **Huang M, Luzerne P, Winters D, Sullivan D.** Measurement of Vitamin D in Foods and Nutritional Supplements by Liquid Chromatography/Tandem Mass Spectrometry. *Journal AOAC International*, 2009; 92(5): 1327-1335.
12. **Food Standards Australia New Zealand.** Australia New Zealand Food Standards Code. Canberra: FSANZ. Available from <http://www.foodstandards.gov.au/foodstandards/foodstandardscode/> (accessed 9th February, 2010)
13. **Australia New Zealand Food Authority.** AUSNUT – Australian Food and Nutrient Database 1999. Canberra: ANZFA, 1999.
14. **Pennington JAT.** Applications of food composition data: Data sources and consideration for use. *J Food Composition & Analysis* 2008; 21: S3-S21.
15. **Food Standards Australia New Zealand.** The Australian Key Foods Program 2006-2008. (In press)
16. **Sobolewski R, Cunningham J, Mackerras D.** Which Australian food composition database should I use? *Nutrition and Dietetics*, 2010; 67:37-40.
17. **Cunningham J, Dugbaza J, Mackerras D.** Update on trans fat intakes. *Australasian Epidemiologist*, 2010;6.