Strategies for Adding and Documenting Data for New Foods

Gail G. Harrison[1], Myra L. Muramoto[2], Magda A. Shaheen[1],and Nadia Taha Saleh[3]
[1]UCLA School of Public Health (Los Angeles), [2]University of Arizona College of Medicine (Tucson, AZ), [3]Agricultural Research Centre, Ministry of Agriculture (Egypt)

This work was supported by funding from the Lesotho Highlands Development Authority through the Consortium for International Development, the Ministry of Agriculture of Egypt, and the US Department of Agriculture (Cooperative Agreement #58-319R-3-008).

Introduction: The Need For Suitable Systems For Handling Of Food Intake Data In The International Context

In international nutrition research, there has long been a need for manageable, self-contained systems which can be used to enter, manage and analyze food intake data at the periphery - i.e., close to the site of data collection - and which are based on adequate, well-supported food composition data. Until such systems could be developed, food intake data from developing countries have been very cumbersome to analyze and have generally been doomed to appear either long after the study had been completed or with nutrient estimates based on incomplete and out-of-date food composition analyses. The advances in database development, maintenance and management which have benefitted large clinical trials and population surveys in the US and Europe in the last decade or so are only recently becoming accessible in reasonable formats to investigators in other parts of thee world.

There are several requirements for adequate systems for international use. First, the system should be based on state-of-the-art food composition information with the possibility for regular updating as new information becomes available. Second, the entire system should be self-contained for local analysis capability - that is, it should not require that data be sent elsewhere for analysis, and it should be manageable on currently available microcomputer systems. Third, a great deal of flexibility in adding new recipes and altering existing recipes is required, including the ability to specify or change fat and water retention/loss factors. And fourth, it should be possible to add new foods and nutrient information from published or other sources. With these four requirements met, one would have a manageable, state-of-the-art system which would be adaptable to a wide variety of food environments and cuisines.

Currently Available Systems: Worldfood And FIAS/FFDEAP

Currently, there are to our knowledge only two currently available systems which meet most of these requirements. One of these has been very recently released by the University of California, Berkeley, the "Worldfood System" (Calloway and Murphy, 1994). Based on work done in the mid-1980s in the context of the USAID-supported Nutrition CRSP (Collaborative Research Support Program) in Mexico, Egypt and Kenya, this system matches country-specific foods to a mini-list of 195 foods based on their nutrient composition. The system is menu-driven and includes complete values for 53 nutrients; the data are from published food composition tables, with imputed values if none are available. The user accesses a country-specific food list, which the software cross-references to the appropriate food item on the mini-list, or in the case of mixtures to multiple mini-list foods. The system has thus far been designed for six countries: Mexico, Kenya, Egypt, Indonesia, Senegal and India. Guidelines are provided for updating or creating new cross-reference files. The cost is quite reasonable, and the price structure includes a deep discount for investigators in developing countries.

The other system which meets most of the requirements outlined above is the one we have been utilizing in a variety of populations, namely the Food Intake Analysis System (FIAS) developed by the USDA and the University of Texas, and its companion system for analysis of food frequency data, the Food Frequency Data Entry and Analysis Program (FFDEAP). These systems are more expensive and require more computer capability, but are well-maintained and are based on a much more extensive food and ingredient list. The database contains both the Primary Data Set (approximately 2500 foods selected from the USDA Handbook 8 and corresponding nutrient profiles for 30 nutrients) and the Survey Nutrient DataBase which contains approximately 6000 of the most commonly consumed foods in the United States population, including both single ingredients and multiple ingredient recipe foods. The menu-driven system allows direct data entry and on-line coding. The system allows creation of new user recipes and modification of existing recipes including the alteration of water and fat retention/loss factors. While Version 1.0 of FIAS did not allow for the addition of new foods, the current version (2.3) has this capability.

We have been using the FIAS system for several years in international work, and have with the support of both USDA and University of Texas staff found ways to adapt the system to the needs of specific dietary patterns and food preparation methods. This paper will present some of that work, including the solutions to specific problems we have encountered. Specifically, I will focus on two pieces of research: the Lesotho Highlands Health Survey, Phase IA, and a currently ongoing project which is focused on the development of a pilot for a national food consumption monitoring system for Egypt, in cooperation with the Agricultural Research Center in Cairo.

The Lesotho Highlands Health Survey (LHHS), Phase IA, was carried out in 1991-92 in a remote highlands area in the mountains of Lesotho in Southern Africa (Muramoto & Harrison, 1993). The work was done through the Consortium for International Development (Tucson, AZ) under a contract with the Lesotho Highlands Health Authority. The purpose of the study was to provide a comprehensive baseline assessment of human health in a region to be affected by the construction of a large dam and reservoir. This construction is part of a very large water development project which will include several dams, reservoirs, tunnels and other construction and will ultimately change the course of important rivers which have their headwaters in the Maluti Mountains, enabling Lesotho to sell its precious natural resource, water, to neighboring South Africa for agricultural production. Because of the potential for environmental change resulting from the project resulting in changes in human health and animal health, the Government of Lesotho commissioned the LHHS to provide a baseline set of data.

The survey was carried out in two sequential cross-sectional surveys, one in winter and the other in summer, on two separate but equivalent samples including 588 households and more than 1600 individuals. The survey included collection of data on anthropometric measurements, clinical signs of nutritional deficiencies, household food security, food frequencies on all household members, and quantitative 24-hour recalls of food intake on selected household members. FIAS, Version 1.0, was utilized for analysis of the 24-hour recall data and FFDEAP for organization and analysis of the food frequency data.

The second study which has provided us with experience in adapting FIAS is an ongoing effort to assist the Agricultural Research Center of the Ministry of Agriculture in Egypt to develop a food consumption monitoring system for the country (Galal and Harrison, 1992). This work is being carried out with financial support from the US Department of Agriculture under the National Agricultural Research Program of the Ministry of Agriculture. The pilot phase of this effort, which is now in the field, is collecting data on a representative sample of approximately 7000 households in rural and urban areas of five of Egypt's 24 governorates. The design includes questions regarding food acquisition and food security, a household-level food frequency qustionnaire, and quantitative 24-hour recalls on a child under

12 years of age if present and that child's mother or female caretaker. We are utilizing FIAS, Version 2.3, modified specifically for the Egyptian context, for analysis of the 24-hour recall data.

In both of these studies, interviewing protocols, data collection instruments, data entry protocols and recipe development required development specifically within the context of the culture, language, food supply, and food preparation techniques of the population. In particular, the ability to add and document new foods and recipes to the database is critical. I would like to review several of the problems we have encountered and the ways in which we have approached solving them or approximating solutions. These problems arise mainly due to the generation of large files of user recipes, the necessity to change the naming of foods and/or units of measurement to local convention in order to reduce error; and variation in nutrient composition of basic ingredients and of prepared foods.

1. The need to create a relatively large number of user recipes to accurately represent local food preparation techniques poses several challenges. One is that multiple creators of recipes may create recipes with only slight differences and with different or the same names. This required, in both projects, frequent (daily or almost daily) reconciliation of the recipe files with discussion and decision making about similar recipes. Another problem is that the FIAS program requires scrolling through the entire user recipe file in order to locate a user recipe; they cannot be searched or sorted within the program. We solved this problem in Lesotho by creating a system for grouping recipes by number, with those based on similar ingredients sharing adjacent numbers.

2. Naming conventions in other countries, even in translation, differ from those employed in the US-based systems. We found that creation of user recipes was the best way to handle these discrepancies in order to minimize error, rather than relying on field data collection staff to continually make the translational effort. For example, "rice" in the Egyptian cuisine is always made with fat or oil, closer to a simple "rice pilaf" than to plain "rice" in the US diet. Rather than require data entry personnel to remember that "rice" is really something else in the system, it was sensible to create a user recipe entitled "Egyptian rice".

Names of measures, even when the measures were part of the program, also differed. For example, in Lesotho what is called a "baby spoon" in FIAS is called a "teaspoon" and what FIAS calls a "teaspoon" is locally termed a "dessert spoon". This did require a constant effort to convert quantities, the responsibility for which we placed on data entry staff rather than field data collectors.

3. The inability to create recipes using household measures rather than gram weights has been a cumbersome problem. It is tempting to try as much as possible to modify existing recipes instead, but this works only if the overall recipe weight does not change by more than 5%. Our approach to dealing with this constraint, in both locations, was a test kitchen to derive the proper weights as well as water and fat retention factors.

4. Water retention factors in some staple dishes in the cuisine in Lesotho exceeded the limits of the program. Many of the "soft" or more liquid maize or sorghum porridges consumed in Lesotho have considerable amounts of water added in preparation; compared to the dry ingredient, the final cooked food will increase in volume nine-to ten- fold. We simply increased the quantity of water or the water retention factor until the recipe approximated our test kitchen data.

5. Fermented foods are common in many African diets, and fermentation is a preparation process not available in FIAS. In Lesotho, the most common fermented foods are "sour" soft corn porridge (*motoho ea poone*) and home-brewed beer (*joala ba sesotho*). To construct appropriate recipes within FIAS, we relied

heavily on consultation with local experts from the Nutrition Unit of the Lesotho Ministry of Health and the Foods Sciences Department of the Lesotho Agricultural College for data on nutrient composition of the prepared foods. The major problems in recipe construction center around the presumed changes in nutrient bioavailability as a result of the fermentation process, including improvements in protein quality and in the availability of micronutrients including zinc, calcium magnesium, iron and vitamin B_{12}. Our procedure for creating approximately valid recipes was to first prioritize nutrients in terms of their importance for later data anlaysis based on information about the common nutritional problems in the area. Then we kitchen-tested the recipe for water retention, compared the nutrient composition of the recipe as calculated by FIAS to published nutrient composition data from Africa. The existing recipe was then modified so that the final FIAS-generated nutrient composition matched the published source with regard to the highest-priority nutrients (for these recipes in this setting, our first priorities were for niacin, thiamine and riboflavin). To achieve the desired alcohol content for *joala*, grain alcohol was simply added into the recipe until the alcohol content of the FIAS-generated nutrient data matched the alcohol content from published sources.

6. Perhaps the most difficult problem we have faced is that the USDA nutrient composition database reflects levels of nutrients which meet the US legal standards for enrichment and fortification for products which are enriched or fortified under US law. A wide variety of wheat-, rice- and corn-based products are affected, as well as milk and margarine. We have over the last several months been working to create a non-enriched, non-fortified version of the nutrient database using Handbook 8 values for non-enriched flour and baked products and fortification/enrichment standards for other products. The University of Texas is currently working with us to make the programming modifications to assure retention of these values through recipe calculations.

Conclusions

It is very clear that the interest in and demand for adequate systems for analysis of food consumption data in developing countries far exceeds the resources for development of these systems locally and even regionally at this time. In the interim, FIAS provides a useable if not perfect option which with fine-tuning and adjustment we have found quite servicable. This fine-tuning, however, requires careful test kitchen procedures and knowledgeable professionals in terms of food composition at the field and data management levels.

References

Calloway DH and SP Murphy. Overview of the UCB Worldfood Dietary Assessment System. Berkeley, CA: 1994.

Galal, OM and GG Harrison. Development of a Pilot Food Consumption Monitoring System for Egypt. Proposal submitted to the US Department of Agriculture, 1992.

Muramoto, ML and GG Harrison. Nutrition Survey, Lesotho Highlands Health Survey, Phase IA. Final Report Submitted to the Lesotho Highlands Development Authority. Tucson, AZ: Consortium for International Development, 1993.