

Application of Food Composition Database to Epidemiologic Studies of Multiethnic Populations

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This paper includes our activities in developing diet history questionnaires and supporting food composition data for epidemiologic studies in Hawaii, the South Pacific Islands, and Singapore.

Hawaii

In Hawaii, the overall objective of our epidemiologic research is to identify dietary risk and protective factors for cancer that will lead to its control and prevention. Our multiethnic and multicultural population, which includes primarily Japanese, Caucasian, Hawaiian, Filipino, and Chinese groups, provides a natural human laboratory for our studies. These ethnic groups vary in their incidence of several cancer sites. For example, stomach cancer is considerably higher among the Japanese and Hawaiians than the other ethnic groups. Colon cancer shows nearly a two-fold difference between Japanese and Filipino men, whereas a similar difference is found for breast cancer between Caucasian and Filipino women. Among Hawaiians, who have a high fat intake, the incidence of breast cancer is high. Yet, colon cancer, usually associated with a high fat diet, is low among this ethnic group. Furthermore, the rate of lung cancer among Hawaiian males is twice that of Japanese males, despite the fact that their smoking rates are similar.

The importance of environmental factors, particularly diet and other lifestyle practices, in cancer incidence is revealed in migrant studies. For example, breast cancer rates are about twice as high in first generation Japanese migrants to Hawaii, as compared with Japan, and the rates in second generation Japanese women are nearly double that of the first generation. For colon cancer, there is a more rapid change, with incidence rates in the first generation Japanese migrants as high as the second generation and comparable to the Caucasian population in Hawaii. Even the Caucasians show differences based upon place of birth. The migrants from the U.S. Mainland have substantially lower rates of gastric cancer than those born in Hawaii. The difference may be due to the longer exposure to salty Oriental foods, which have been associated with this cancer in epidemiologic studies.

Although we examine all potential risk factors in our research, our major emphasis has been the exploration of dietary hypotheses related to cancer etiology. We have found that adults, in particular, among the five ethnic groups differ substantially in their food and nutrient intakes. For example, consumption of fat and protein is significantly higher among the Caucasians and the Hawaiians than among the three Asian populations. Comparison of fat intakes with breast cancer incidence rates reveals a very high correlation, similar to what is observed internationally.

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In our epidemiologic studies, data are obtained by personal interview, usually in the home. The interview includes a comprehensive diet history to obtain the frequencies and quantities of selected food items consumed during a usual year. The food items for the questionnaire are selected from three-day measured food records of representative samples of each ethnic group, with supplementation of seasonal and popular fast-food items that may not have been recorded. The food records, along with personal visits to markets, restaurants, and private homes, have been valuable for identifying foods for the diet history and developing the nutrient database. Some ethnic foods, such as sushi, dim sum, and chow mein (stir-fried noodles) are popular with all persons and are included in the diet history. Other items tend to be eaten more by a single ethnic group, such as poi (fermented taro paste) by the Hawaiians, pinacbet (a mixed dish of vegetables, fish sauce, and meat or fish) by the Filipinos, and sashimi (raw fish) by the Japanese. Foods eaten frequently by only one ethnic group are also included in the diet history if they contribute substantially to the group's dietary intakes. This results in a fairly long history and also requires considerable supplementation to the database.

We include both frequency and quantitative data in our diet histories because food records have revealed differences in serving size of various items among the ethnic groups. Photographs illustrating three different portions of those foods without defined serving units permit the subject to visualize and select amounts consumed and increase the validity of the diet history.

The foundation of our food composition database is the USDA nutrient database (1). The USDA data are updated annually. However, the data set used for analysis in a particular study is identified and maintained for reference or reanalysis. Our food composition data base is supplemented with items from food composition tables of Japan (2), the Philippines (3), East Asia (4), other countries as needed, commercial publications, and research papers. The source of each nutrient (or other component) for each food item is documented in the data set. In addition, we have expanded the database horizontally with analytical values of carotenoids (5,6) and nonstarch polysaccharides (7-9), and published values of starch, tocopherols, nitrites, and other dietary components from various references for testing particular hypotheses.

South Pacific Islands

During the past few years, we have conducted epidemiologic studies in selected Pacific Island populations whose incidence rates of some cancer sites show wide variation. For example, the incidence of colorectal cancer among Hawaiians (includes part-Hawaiians) and Maoris (New Zealand natives) is about double that of Cook Islanders, all of whom are Polynesians. Melanesians living in New Caledonia have one of the highest rates of stomach cancer among South Pacific Islanders, whereas

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Melanesians living in Fiji have the lowest rates. Of particular interest are the low rates of lung cancer in the Melanesians and Indians living in Fiji, which do not appear to be due to a lower prevalence of smoking. In fact, the Cook Islanders have lower smoking rates than the Fijians, but have lung cancer incidence rates that are 6 to 10-fold higher.

This finding suggested that one of more factors in the environment may be protecting the Fijians and Indians from lung cancer. During a visit to Fiji a few years ago, Dr. Brian Henderson, who is the director of the University of Southern California (USC) Comprehensive Cancer Center and an epidemiologist, observed that a vegetable known as "bele" was consumed in large quantities by this population; he raised the possibility that "bele" might be protective. "Bele" is a dark leafy green vegetable and a member of the hibiscus family. Because epidemiologic studies have found inverse associations of β -carotene or green and yellow vegetables with lung cancer and incidence rates of cancer vary among the Islanders, we decided to conduct studies with a dietary focus among several island populations. The research was a cooperative undertaking sponsored by the USC Comprehensive Cancer Center, the University of Hawaii (UH) Cancer Research Center, the South Pacific Commission (SPC), and the Ministries of Health in each of the islands. We also had the assistance of the Nutrient Composition Laboratory of the USDA for analysis of the carotenoids in vegetables and fruits of each island.

For these studies, we selected random samples of 200 to 250 semi-rural adults in each island, who were interviewed by trained public health workers. The major component of the interview was the diet history, which included more than 100 traditional and western foods. Both frequencies and estimated amounts of each item were obtained. Our aim was to obtain estimates of 90% or more of the usual food and nutrient intakes consumed during the past month. We also obtained data on seasonal fruits high in vitamin C and carotenoids, which may not have been available during the period of the survey. In addition, anthropometric and blood pressure measurements, blood and urine samples for biochemical analysis, and smoking and alcohol histories were obtained on each subject.

To develop the diet history and the corresponding nutrient database for each island, I worked with a local nutritionist or dietitian. The first step was to obtain a list of all foods frequently consumed, or at least available, their local names, and if possible, information on usual serving sizes. This was done primarily by mail and telephone a few months before the scheduled survey. Prior to each survey, I also reviewed all relevant published reports of past dietary surveys conducted in the area and consulted with the SPC nutritionist for further information. After drafting the diet history and conferring with the local nutritionist, I continued to make further modifications until we had a reasonably good document. However, in the field, we

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inevitably found that some items should be deleted due to their rare use, whereas others should be added.

Before and after arrival on an island, I worked on the development of an appropriate food composition database. The East Asia Food Composition Table (4), although dated, was a useful resource, as well as unpublished information from the South Pacific Commission and New Zealand which exported some foods to several of the islands. In each area, I visited the local open markets to observe the different vegetables, tubers, and fruits. I also checked the available meat, poultry, and fish items and made "educated guesses" about the particular "cuts" and their approximate fat content. Appropriate values were then selected from USDA tables. We used these data whenever possible because other resources were often incomplete for nutrients of interest. There were problems in finding a few food items, such as bats and worms which were consumed in New Caledonia! Worms were eaten raw or grilled by a few persons. However, my review of the literature and consultation with the SPC were unproductive, so worms were excluded from the diet history. With the help of the SPC, I found the proximate composition of bats in a published research paper.

I also checked packaged and canned foods in each area to obtain a better idea of their composition. For example, flour, rice, grains, breads, and other baked items were generally not enriched or fortified with nonfat dry milk solids. Again, I selected data from USDA tables. Most canned fruits and vegetables were comparable to our products. There were exceptions, however, such as items exported from France to French Polynesia (Tahiti) and New Caledonia. For example, a popular item in French Polynesia was "Cassoulet", a canned product similar to our "pork and beans". We bought a can, separated and weighed the legumes, sausage, salt pork and tomato sauce, and developed a "recipe" for the item. I followed this practice with several prepared mixtures. For some traditional or local dishes, I checked the cookbooks developed by islanders, consulted various health workers and their families to verify the foods and measurements, and then developed "recipes" for the database.

In our research, we have been particularly interested in obtaining dietary estimates of the carotenoids because of their role as anti-oxidants. After several consultations with Gary Beecher, Director of the USDA Nutrient Composition Laboratory, we obtained samples of the vegetables and fruits that were potentially good sources of the carotenoids in each island. These were prepared in the usual way, either raw or steamed, then frozen, and shipped to the USDA laboratory for carotenoid analysis. For most items, I assumed that all of the common nutrients were comparable to the reported values of the same foods in published food composition tables. Obviously, there would be some geographic variation, which would introduce systematic errors. Some items, such as wild fern, saijen, and wild Chinese cabbage, were listed in the tables of East Asia, the Philippines, New Zealand, or the SPC. In

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some cases, we found photographs of a vegetable in a recipe book or other reference and were able to classify an unknown food. Pictures were particularly helpful for identifying the innumerable variations of Chinese cabbage.

We also weighed the food items in the questionnaire according to their usual serving sizes and developed various visual aids to assist subjects in estimating amounts consumed. Tubers were cut in common sizes, weighed, varnished, and kept in the refrigerator each night for the entire survey. In some of the islands, we weighed the amounts of foods that were usually consumed in particular dishes. In Fiji, almost all of the people used metal serving bowls of various sizes, called "pyalis", for eating and drinking. We measured their capacities, weighed the amounts of rice, noodles, meat, and beverages in each size bowl "a priori", and used the bowls for estimating amounts consumed. We also asked the local interviewers to estimate medium and large servings of various vegetables. Polaroid pictures of the two serving sizes were then taken of each vegetable and used in the interviewing.

A major problem was estimating the amount of coconut cream consumed with vegetables; this practice was common in all of the islands. Mona Chand, the chief nutritionist in Fiji, suggested a systematic procedure. She squeezed several coconuts and found that the average yield was 8 ounces of cream. For this item, the interviewer asked the subject the number of coconuts used each day in cooking for the family and the number of persons in the household. With this information, we derived the estimated per capita daily intake of coconut cream.

Although the carotenoid data are not available for all of the islands as yet, we have preliminary information which suggests that dark green vegetables are protective of lung cancer risk. Our data revealed that the Melanesians and Indians living in Fiji consumed significantly greater amounts of these vegetables than other islanders included in our surveys. A comparison of dietary intakes with lung cancer incidence revealed an inverse correlation of 0.92, suggesting that anti-oxidants or other components in these foods are most likely protective of this cancer.

Singapore

Recently, I have been involved in developing a diet history and a nutrient database for a study to be conducted among Cantonese and Hokkien adults in Singapore. These people consume a large portion of their food in "hawker centers" which consist of various entrepreneurs who prepare specialty items, such as noodle, rice, or tofu entrees, soups, desserts, and beverages. I visited these centers, as well as the local markets to obtain a better picture of the available foods. I also met with two groups of dietitians in Singapore, who had previously purchased a variety of "hawker dishes", taken them apart to weigh the ingredients, and obtained information from the seller on spices and fats used in their preparation. The contents and weights

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of each ingredient in these mixed dishes were listed as recipes. These items will be added to the database. We also weighed and photographed various fresh fruits, vegetables, meats, and fish for identifying the foods and developing the diet history and nutrient database.

To have a rational basis for designing the questionnaire, trained interviewers are following a specific protocol and are collecting two 24-hour recalls (one weekday and one weekend day) from a representative sample of 200 Cantonese and Hokkien adults during a four-month period. The recalls will be analyzed to identify the food items for inclusion in the diet history and the database. We plan to administer the questionnaire to the same subjects after an interval of a few months to ascertain its validity.

The database for this study needs to be supplemented with a large number of food items, including rice noodles, various soybean and tofu products, all conceivable parts of pork, a variety of dried fruits and vegetables, different kinds of rice porridge, 50 or more hawker dishes, and other foods. All items reported in the 24-hour recalls will be included. In addition, seasonal fruits and vegetables that may not have been reported, as well as particular items for testing dietary hypotheses, will be added. Several references will be utilized for the database. USDA data will be selected for items comparable to American foods, whereas the Chinese (10), Malaysian (11), and East Asia (4) tables will be used for items unique to Singapore. In some cases, it will be necessary to impute values for those items which appear similar to the known composition of comparable foods.

Conclusions

The dietary data from these epidemiologic studies will obviously lack the precision of weighed or measured food records. However, the findings will reflect the usual diets of these populations, differentiate between persons with diverse dietary patterns, and provide further clues for understanding the relationship of diet to cancer etiology, which is the first step to prevention.

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