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The Pacific Tracker (PacTrac): Development of a dietary assessment instrument for the Pacific

Carrie L. Martin^{a,*}, Suzanne P. Murphy^a, Rachael T. Leon Guerrero^b, Nicola Davison^{c,d}, Yun Oh Jung^a, and Rachel Novotny^{c,d}

^aCancer Research Center of Hawaii, University of Hawaii, 1236 Lauhala St., Honolulu, HI 96813, USA

^bCollege of Natural and Applied Sciences, University of Guam, UOG Station, Mangilao, GU 96923, USA

^cDepartment of Human Nutrition, Food and Animal Sciences, University of Hawaii, 1955 East West Road, Honolulu, HI 96822, USA

^dKaiser Permanente, Center for Health Research Hawaii, 501 Alakawa Street, Honolulu, HI 96817, USA

Abstract

The Pacific Tracker (PacTrac) is a new dietary assessment program that can be used to evaluate dietary data for nutrition studies in the Pacific Islands. PacTrac is a modification of the Interactive Healthy Eating Index (IHEI) developed by the US Department of Agriculture's Center for Nutrition Policy and Promotion as an online interactive dietary assessment tool for use by the public. Creation of PacTrac required several modifications to the IHEI, including a function to save data to allow for later access and addition of Pacific Island foods. Sources for Pacific Island foods included the Cancer Research Center of Hawaii (CRCH) Food Composition Table (FCT) and recipes from Guam and the Commonwealth of the Northern Mariana Islands (CNMI). Initially, 344 foods in the CRCH FCT were added to the IHEI. Feedback from pilot sessions indicated it was too large and therefore difficult to navigate. Therefore, we removed the original IHEI database (over 7000 foods) and replaced it with the CRCH FCT (2778 foods) plus 85 recipes from Guam and 40 recipes from CNMI. We are currently using PacTrac to evaluate dietary data in Hawaii, Guam and CNMI.

Keywords

Dietary assessment; Food composition database; Pacific foods

1. Introduction

Advances in computer programming and technology have led to the development of dietary data analysis programs that can provide immediate feedback tailored to the individual regarding nutritional content and overall diet quality. Even with technological advancement, it is still difficult to ensure that a program will be user friendly and achieve the goal of capturing a diet entry that reflects the foods and beverages actually consumed.

Our objective was to design and test a dietary assessment instrument that was appropriate for use in the Pacific Islands. The project was originally undertaken as part of the Healthy Living in the Pacific Islands, Healthy Pacific Child Program (HLPI-HPCP), to evaluate the impact of a dietary intervention study on two islands in Hawaii. The dietary assessment instrument was also used by dietary surveys in Guam and the Commonwealth of the Northern Mariana Islands (CNMI). The purpose of this paper is to describe how the new instrument, named the Pacific Tracker (PacTrac), provides an alternate automated method of collecting dietary data for nutrition studies in the Pacific, an interactive user-friendly nutrition education tool tailored to the diets of Pacific Islanders, and a tool to evaluate dietary intervention studies in the Pacific.

2. The Interactive Healthy Eating Index

PacTrac is a modification of the Interactive Healthy Eating Index (IHEI), which was developed by the US Department of Agriculture's (USDA) Center for Nutrition Policy and Promotion as an online interactive dietary assessment tool for use by the general public. The IHEI used data from the 1994–1996 Continuing Survey of Food Intakes by Individuals (USDA, 1998), the 1995 Food Guide Pyramid (USDA, 1996), and the 1994–1996 Healthy Eating Index (HEI) (Bowman et al., 1998). Using the IHEI, an individual is able to create a login name and enter their age, gender, and weight. After the user is logged in, they can enter and evaluate their dietary intake and are provided feedback on the quality of their diet. The IHEI generates the nutrient content of the diet entry (energy, protein, carbohydrate, fat, cholesterol, dietary fiber, and 16 vitamins and minerals), a comparison of how the diet adheres to the Food Guide Pyramid, and a score related to components of the HEI (this includes adherence to the Food Guide Pyramid, percent of calories from total fat and saturated fat, amount of dietary cholesterol, sodium intake, and dietary variety). Using the IHEI, it is possible for the user to track the HEI score for up to 20 days to assess any changes over time. Feedback is provided in a user-friendly manner, such as through the use of emoticons in the HEI score output. The user has the ability to select a variety of links within the website to obtain additional information.

The IHEI also contains a physical activity component that allows the user to enter their daily physical activity and determine the associated energy expenditure. The physical activity component was not modified or used in the HLPI data collection; therefore the focus of this paper is the dietary assessment tool.

The IHEI has now been replaced by MyPyramid Tracker, an interactive dietary assessment tool based on MyPyramid (USDA, 2005b). However, many of the features of the IHEI have

been retained. PacTrac was developed and tested prior to the availability of MyPyramid Tracker, and thus continues to resemble the IHEI.

3. Modifying the IHEI to become PacTrac

The USDA Center for Nutrition Policy and Promotion provided a copy of the IHEI program, databases, and associated documentation for use in developing PacTrac. Several modifications to the IHEI were necessary to create PacTrac: (1) the addition of a function to save entered dietary data and allow access at a later date; (2) the addition of foods specific to the diets of the Pacific Island population; (3) modification of supporting databases; and (4) modification of the user interface.

3.1. Saving entered dietary data

The original IHEI was not designed to collect and store information for later access and analysis. To create PacTrac for use as a research data collection tool, it was necessary to modify the IHEI to save entered information. A member of the programming staff at the Cancer Research Center of Hawaii (CRCH) modified the original IHEI program to save entered data files so each dietary entry could be identified and merged according to a uniquely assigned identification code. A separate external program was also created to merge the saved data files and perform the calculation procedures to provide diet nutrient analysis, Pyramid servings, and a variety score. The creation of this external program allows researchers using the program to have access to the same data analysis output as the IHEI program, but decreases the potential for human error by automating the process of capturing the data and recreating the data analysis output.

3.2. Development of the database for Pacific Island locations

Identified sources of compositional data and recipes for Pacific Island foods included: the CRCH Food Composition Table (FCT), recipes from Guam and the Commonwealth of the Northern Mariana Islands (CNMI), and the Pacific Islands Food Composition Tables. Recipes were collected in CNMI as part of the HLPI and those from Guam were collected as part of a partnership project between CRCH and the University of Guam. The second edition of the Pacific Islands Food Composition Tables (Dignan et al., 2004) is a source of nutrient composition data for foods consumed in the Pacific Islands which we intend to add to PacTrac in the future.

3.3. Modification of the IHEI database

Additions to the IHEI database were fairly complex in that a number of different database files had to be updated for each new food code. To add a food item to the database, the following information was needed: food description, gram weight of a portion (assigned for each portion measure, such as a slice, a teaspoon, etc.), portion measure description, subcode description (when more than one food description was associated with the same food code), the number of Pyramid servings per 100 g, and the contribution of the food to dietary variety (i.e., which of approximately 300 agricultural commodity types are represented by the food (Bowman et al., 1998; Foote et al., 2004)). Foods that were recipes were added in the same manner as a single food, so that information on the nutrient profile, the number of Pyramid

servings, and the contribution to dietary variety had to be calculated from the individual ingredients prior to adding the recipe to the IHEI database. This required first determining nutrient values, Pyramid servings, and the contribution to dietary variety for each individual ingredient, and then using an external program to calculate these amounts per 100 g of the recipe.

3.4. Modification of the user interface

Modifications were made to the user interface to reflect the PacTrac name and CRCH affiliation. Background information and a section for frequently asked questions were also modified to reflect the PacTrac project. Fig. 1 provides a screen shot of the PacTrac homepage (<http://pactrac.crch.hawaii.edu/>).

4. Adding the CRCH food composition data to PacTrac

The CRCH FCT created and maintained by the CRCH Nutrition Support Shared Resource (NSSR) staff, houses nutrition information for approximately 3100 foods and up to 120 food components for each food. Sources of nutrient data for the FCT include: the USDA National Nutrient Database for Standard Reference (USDA, 2005a), food composition tables from other countries such as the Food Composition Table for Use in East Asia (Leung et al., 1972) and McCance and Widdowson's The Composition of Foods (Holland et al., 1991), analytical data from published literature, and in-house laboratory analyses.

Related to the diverse ethnicities present in Hawaii, the focus of the CRCH FCT is on foods typically consumed in Hawaii and other areas of the Pacific. Unique Pacific Island foods carried on the FCT are often recipes rather than single food items. The IHEI food description data file was reviewed and compared to the food description data file for the FCT. Foods carried on the FCT that did not appear in the IHEI file were identified and considered for addition to the IHEI database. A total of 344 foods carried on the FCT were identified for addition to the existing IHEI database to create the PacTrac database. Table 1 provides examples of these selected foods. Although some single-food items (fruits, vegetables, and meats) were identified for addition, the majority of food codes added to the database were recipes representing a variety of ethnicities such as Hawaiian, Japanese, Chinese, Korean, Thai, and Filipino.

5. Adding foods from Guam and CNMI to PacTrac

Through a partnership with the University of Guam, funding was obtained to update the PacTrac database with foods typically consumed in Guam. A total of 85 recipes from Guam were identified for addition to PacTrac. The source for 68 recipes was the Island Foods are Healthy: Guide for Nutritious Diets (Benavente et al., 1999). Recipes in this book were compiled by the Guam Cooperative Extension and were created by comparing recipes from three or more local sources to ensure that they were representative of typical methods of preparation. Additional recipes were collected from local cookbooks by local Expanded Food and Nutrition Education Program staff. Table 2 provides examples of the foods descriptions from Guam. Descriptions were added to PacTrac using the commonly recognized Guam description along with an English description.

Through the HLPI project, funding was also available to add recipes from CNMI to the PacTrac database. A total of 40 recipes from CNMI were identified for addition to PacTrac. Recipes were collected by local Expanded Food and Nutrition Education Program staff and are representative of the typical methods for preparing foods. Specific information was obtained about the ingredients and amounts of ingredients for each recipe. For example, food information collectors were asked to indicate whether ingredients were fresh versus canned or frozen, or if an ingredient was used in preparation but not necessarily consumed (e.g., if an item was wrapped in banana leaves and baked were the banana leaves discarded or consumed). It is common in some Pacific Islands to use a finger method of measuring (e.g., three finger pinch of salt). If this measure was reported for a recipe, food information collectors were asked to have multiple people measure the ingredient, weigh each person's measure, and provide the average gram weight. Food information collectors were also asked to provide the recipe yield and gram weight measures as well as descriptions of portions (e.g. a slice, cup, piece). Many recipes from CNMI had descriptions similar to those from Guam. To distinguish the different locations an identifier was included in the recipe description added to PacTrac that indicated either Guam or CNMI origin. This ethnic identifier was also used for other ethnic recipes (e.g., Korean, Filipino, Chinese, etc.).

6. Developing and testing different versions of PacTrac

6.1. PacTrac version 1

The initial version of PacTrac consisted of the addition of 344 FCT foods to the original IHEI database. A total of 836 gram-weight measurements of portion sizes (2–3 measures per food) and 25 new portion measure descriptions (e.g., 1 can (7.76 oz), drained, 1 slice

$(2'' \times 1\frac{1}{2}'' \times 1/16'')$) were added. Pyramid servings and the contribution to dietary variety were also added for each FCT food.

In addition to the new food codes added from the FCT, changes were made to some of the existing IHEI codes. Some of these changes were modifications to food descriptions. For example, the IHEI description “Octopus, Cooked” was changed to “Octopus (Tako), Cooked” to reflect the Hawaiian name. The IHEI description “Potato Salad” was changed to “Potato Salad (USDA)” to distinguish it from the Hawaii recipe, which includes more mayonnaise. In addition, some IHEI codes were deleted when an FCT replacement code was determined to be more appropriate. For example, the IHEI code “Portuguese Bean Soup” was replaced by the FCT code as the FCT recipe reflected the typical method of preparation in Hawaii.

Pilot testing of PacTrac Version 1 was conducted to test usability and comprehensiveness of the database. Four children (age 8–11 years) and their mothers participated in the original pilot sessions held in a computer lab at the University of Hawaii at Manoa. The children and mothers were separated with one assistant assigned to the children and one assistant for the mothers. The participants were provided a user guide for PacTrac and various measuring cups and spoons. They were instructed to enter into the program all foods and beverages consumed the previous day from the time they woke up until the time they went to bed. The

participants entered all dietary data and the assistants were available to address any questions.

Evaluation of the data entry from the initial pilot sessions for PacTrac Version 1 indicated that entry by the participants themselves was not appropriate for the goal of obtaining research quality data. Feedback from participants indicated that the identification and entry of foods was difficult without previous experience with the program.

Additional pilot testing of PacTrac Version 1 was conducted on two more occasions with five children (age 8–11 years) and their mothers. Both sessions were held off campus and used laptop computers with one assistant working with each mother–child pair. For these pilot sessions, 24-h recalls were collected from the children and trained assistants entered all dietary data into the laptop. The mothers were present during the recall and were asked to assist the child with the recall when needed. Food models and measuring cups and spoons were available and a 5-step multiple-pass recall method was followed (Conway et al., 2003).

Evaluation of the second pilot sessions for PacTrac Version 1 indicated that entry by a trained assistant was more efficient. In addition, the multiple pass recall method produced more comprehensive dietary information than was obtained when the children entered their own dietary data.

Results of the pilot testing for PacTrac Version 1 also indicated that the number of foods included in the IHEI database was too extensive. The amount of time required to search and determine the appropriate food code to enter was hindering the efficiency of data entry. Additional changes to the food codes included in the PacTrac database were necessary.

6.2. PacTrac version 2

Two options for modification of PacTrac Version 1 were investigated: (1) delete the current IHEI files and replace with CRCH FCT codes, (2) decrease the number of foods currently in the IHEI database using a systematic method of evaluation to determine which of the 7000 codes would be retained or deleted. The tasks required for each option were investigated and it was determined that replacing the files with the CRCH FCT would provide the best results and allow for efficient data entry.

For PacTrac Version 2, a total of 2737 codes in the FCT (including the 344 codes added previously) were identified to replace the IHEI database. A total of 6273 gram-weight measurements and 187 new measure descriptions were added (the original extensive IHEI measure description file was also retained). Nutrient values, Pyramid servings and the contribution to dietary variety were also added for all food codes. All of the original IHEI food codes were deleted from the program data files. A total of 188 codes were not added to PacTrac because they were discontinued in the FCT, present in a form that was highly unlikely to be consumed (e.g., dry, raw, beans), codes for the use of a specific study only, or prototype or unspecified codes for which more specific codes were preferentially added.

6.3. PacTrac version 3 and 4

As described in Section 5, additional updates to PacTrac were performed to add recipes from Guam and CNMI and new foods added to the FCT. PacTrac Version 4 (2006) is the most recent update and contains 2903 food codes, 6486 gram-weight measures, and 202 new measure descriptions.

7. Current users of PacTrac

In addition to the study in Hawaii, PacTrac is currently being used to evaluate 24-h dietary recalls collected in Guam (Leon Guerrero and Murphy, 2006) and CNMI (Novotny et al., 2007). A future comparative analysis, looking at the results of data entry using PacTrac and data entry using established methods at CRCH NSSR, will be done to investigate the quality of data entry using PacTrac for research study purposes. The database is also being integrated into the Hawaii Foods website created by the University of Hawaii at Manoa College of Tropical Agriculture and Human Resources Center on the Family and will be available for public access in the future.

8. Usability of PacTrac

Pilot testing indicated that without familiarity with the program it is difficult to search for foods and choose an exact match or item most closely representing the food consumed. Children in particular appeared to have a difficult time with use of the application, perhaps due to a decreased attention span and issues with errors in spelling food descriptions. The children tended to choose the first food that appeared in the food list regardless of whether the food was the best match to the food they actually consumed. For children, the goal of obtaining research quality data was not met when the children entered their own data into the system. Further modifications to the program to provide prompts or built in checks for data entry may help to enhance the quality of data entry. Once data were entered, the colorful graphics and educational feedback were appreciated by both the adults and children involved in the pilot testing indicating that visual experience is important.

Professional users initially found data entry in PacTrac cumbersome due to the extensive food list, which increased the time needed to search and choose a specific food item. By replacing the IHEI database with the FCT database we were able to decrease the number of food items, but still allow for a wide variety of food choices for data entry. The use of ethnic identifiers in the food descriptions also enhanced searching capability by allowing the user to search by ethnic association.

Another limitation encountered in the creation of the PacTrac database was the difficulty in adapting a pre-existing program for use beyond the scope of the original design. The original program was not intended for research data collection, extraction, and analysis. Adaptation of the program to save data and the creation of an external program to merge and calculate values for the final data files required fairly extensive programming. Additionally, because the programmer working on modifications to the program was not the designer of the original program, there were characteristics of the program that were not initially apparent and which were discovered only through a trial and error period.

9. Future goals and conclusions

Future goals for PacTrac include incorporating additional Pacific Island foods and recipes and increasing the accessibility of the database to others in the Pacific Islands. Because the IHEI has been replaced by MyPyramid, we plan to update PacTrac to reflect current guidelines and recommendations. The specificity of the original database programming is such that it may be necessary to develop a new database system design with updated graphics and calculations.

PacTrac provides a source of nutritional information for Pacific Island foods and a means to perform dietary analysis and provide feedback regarding the quality of the diet. Although there are some limitations to PacTrac, including use of the Food Guide Pyramid rather than the more recent MyPyramid, it represents an initial step forward in the development of a dietary assessment tool for use in Pacific Island populations.

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Fig. 1.
PacTrac homepage.

Table 1

Examples of foods added to PacTrac from the Cancer Center of Hawaii food composition table

Fruit	Guava, strawberry, raw
	Pepaya, red, ripe, raw
	Persimmons, native, raw
	Mango, green
	Mountain apples, raw
Vegetables	Beans, winged, cooked, drained
	Burdock, cooked, drained
	Chinese broccoli, cooked
	Lotus root, cooked, drained
	Tree fern, cooked
Soy products	Nano (fermented soybeans) (Japanese)
	Foo jook (dried tofu skin), cooked (Chinese)
	Tofu gan (pressed tofu) (Chinese)
Meat/fish	Abalone, canned
	Kalua pig (smoked shredded pork) (Hawaiian)
	Pork blood, cooked
	Sausage, Portuguese
	Sea snail, cooked, moist heat
Mixed dishes	Green curry, with beef, no vegetables
	Loco moco (beef with egg, rice & gravy)
	Chicken long rice (chicken & mung bean noodles) (Hawaiian)
	Chicken luau (taro leaves, coconut milk & chicken) (Hawaiian)
	Oyako donburi (chicken & egg over rice) (Japanese)
	Soup, tang mein (noodles with meat & vegetables) (Chinese)
	Bulanglang (pork with vegetables) (Filipino)
	Som tam (green papaya salad) (Thai)
	Soup, kook soo (noodle soup with beef & vegetables) (Korean)
Desserts/sweets	Stew, oxtail
	Lumpia, banana, deep fried (fried wrapped banana) (Filipino)
	Bread, mango
	Mochi ice cream
	Pie, chocolate haupia
	Malasada (doughnut) (Portuguese)

Table 2

Examples of foods added to PacTrac that are typically consumed on the island of Guam

Gollai appan chotda (plantain with coconut milk)
Red rice (rice prepared with achote seed liquid)
Titiyas mai'es (corn tortilla prepared with coconut milk)
Bistek (beef with vinegar sauce)
Chicken corn soup (soup with chicken and corn)
Chicken kelaguen (chicken & fresh grated coconut)
Eskabechi (fish & vegetables)
Fish relyeno (fish stuffed with egg & onion)
Kadun guihan (fish stew)
Kare-kare (oxtail in peanut butter sauce)
Pork estufao (pork spareribs in vinegar & soy sauce)
Ahu (young coconut with cornstarch dessert)
Bunclos dagu (yam donuts)
Coconut candy (shredded coconut candy)
Rosketi (cornstarch cookies)