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RESEARCH

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Dietary Supplement Use Within a Multiethnic Population as Measured by a Unique Inventory Method

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ABSTRACT

Use of dietary supplements is widespread, yet intakes from supplements are difficult to quantify. The Supplement Reporting study utilized a unique inventory method to quantify dietary supplement use across 1 year in a sample of 397 supplement users. Interviewers visited participants' homes in 2005-2006 to record supplement purchases and the number of pills in each supplement bottle every 3 months. Total use for the year was calculated from these inventories. Participants in this observational study were older adults (average age 68 years) from the Multiethnic Cohort in Hawaii and Los Angeles, CA, with approximately equal representation of men and women and six ethnic groups (white, Japanese American, Hawaiian, African American, Latinos born in the United States, and Latinos born elsewhere). The most commonly used supplement type was one-a-day multivitamins/minerals, which were taken at least once during the year by 83% of men and 73% of women. Other common supplements were vitamin C, fish oil, vitamin E, and bone or joint supplements. Participants used a median of seven (women) and five and a half (men) different supplements during the year. There were few differences in supplement use across ethnic groups for men, but use tended to be highest for white and Japanese-American women. Use of nonvitamin/nonmineral supplements was common among these older adults, sometimes at high doses. When assessing intakes, supplement use should be correctly quantified because users tend to take many different supplements and nutrient intakes from supplements can be substantial. The inventory method may help improve the measurement of supplement use.

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Dietary supplement use is widespread in the United States, with more than 50% of adults taking at least one supplement, and 35% taking a multivitamin/mineral supplement, in the past month in 1999-2000 (1). Furthermore, growth in supplement use has accelerated rapidly in recent years (2,3). Among some segments of the population, such as older adults, use is particularly high (4-8). Furthermore, the dose of a nutrient taken as a supplement often exceeds levels of the same nutrient in the diet. Thus, accurate estimates of total nutrient intakes must include consumption from dietary supplements. For example, mean dietary intake of vitamin C in the 1988-1994 National Health and Nutrition Examination Survey (NHANES) III data for adults 51 to 70 years of age was approximately 100 mg/day from food, and doubled to 200 mg/day when intakes from supplements were included (9). The high level of nutrients available from some supplements may be undesirable. Tolerable Upper Intake Levels (ULs) have been set for many vitamins and minerals and may be used to assess the prevalence of potentially excessive nutrient intakes (10).

Almost all published reports of dietary supplement use are based on self-reported information, and the validity of the collection methods is uncertain (11-16). Although participants are often asked to show their bottles to the interviewer, the list of supplements will be incomplete if the participant forgets to bring some of the bottles or discards others. Information on amounts consumed may also be incorrect, depending on the participant's memory and ability to accurately report frequency of use. As a result, published estimates of supplement use, doses, and nutrient intakes may not be accurate.

The Supplement Reporting (SURE) study was designed to more accurately measure supplement use with a unique inventory system in which interviewers visited participants' home to take an inventory of the contents of all supplement containers. Details of this methodology, and the resulting findings on use of dietary supplements across 1 year by older adults in Hawaii and Los Angeles, CA, are reported in this article.

METHODS

Inventory Protocol

The SURE inventory protocol was developed based on methods used to determine compliance with use of prenatal supplements (17). However, it was refined and extended to consider the simultaneous use of many different products. The SURE protocol required five home visits, one at the beginning of the study, and the other four approximately every 3 months over the course of a year. For the purposes of the study, a dietary supplement was considered to be a product that was intended to supplement the diet, but not to be used as a conventional food. Also, the product's label should identify it as a dietary supplement. Food items such as meal replacement drinks or energy bars were not considered dietary supplements, even if they were highly fortified. At the first in-home visit the interviewer asked the person to collect all dietary supplement containers. Each container was labeled with a sequentially numbered sticker that corresponded to the number on an inventory log that the interviewer maintained. This form was used to keep a continuous list of all supplements taken by the participant during the course of the year. At each visit, the interviewer physically counted all pills in the container and entered the information on the inventory log, along with the original product count on the label. If the supplement was in a form such as a powder or liquid, it was weighed on a portable scale. Participants were asked to save all empty containers, which allowed the interviewer to confirm that they had been emptied. To ensure proper identification, pictures were taken of each container, including the front of the bottle and the Supplement Facts panel.

A copy of the log was left with the participant, who was asked to add any new containers that were purchased. If other people in the household used the same bottles, some pills were transferred to a newly provided (empty) bottle, and the participant was asked to only use pills from this bottle. However, space was also provided for the participant to indicate if others had taken any pills from any supplement bottle, and if so, how many.

Assignment of Supplements to Categories

Each specific dietary supplement was assigned to a category from a predetermined list representing specific types of supplements. The categories could be combined into four broad groups: multivitamins/minerals, single nutrient supplements (subdivided into vitamins and minerals), herbal/botanical supplements, and miscellaneous supplements (eg, fish oils, fiber, and amino acids). Supplements that did not fit within any of the specific categories were put into "other" categories, such as "other multivitamin/mineral combinations." The Figure shows the complete list of 54 supplement types. Supplements were assigned based on the name of the product and the nutrients in the product as shown on the Supplement Facts label. Multivitamin/minerals were defined as supplements containing two or more nutrients.

Quantification of Supplement Use and Nutrient Intakes

The number of doses of each supplement that was taken between the quarterly inventory visits was calculated by subtracting the number of pills in a bottle at the end of the quarter from the number that were in the bottle at the beginning of the quarter, divided by the number of pills per dose. Doses across the year were accumulated for each participant, and then divided by the number of days between the first and last inventory measure to give doses per day. Nutrient intakes from supplements were quantified using the Cancer Research Center of Hawaii's Supplement Composition Table, which was expanded and updated for the SURE study (18). Intakes across the year were calculated for each participant from the doses per day that were taken for each supplement and the nutrient composition of the supplement. Intakes of 15 nutrients that are commonly contained in dietary supplements are included in this report.

Participants

Participants in the SURE study were supplement users selected using stratified random sampling from a previously established multiethnic cohort (19). Potential participants (n=33,697) had previously completed two food frequency questionnaires and a blood draw, and had reported taking dietary supplements. Twenty-four strata were defined by sex, six ethnic groups, and age group ($<$65 years, $\geq$65 years). Separate strata were created for US-born and non–US-born Latinos, because acculturation might affect supplement use. The goal was to retain at least 15 participants in each of the strata, for a total of 360 participants. African Americans and Latinos were recruited in Los Angeles, whereas Japanese Americans, Native Hawaiians, and whites were recruited on the island of Oahu in Hawaii.

SURE participants were recruited from March 2005 to August 2006 and were initially contacted by mail, and then by telephone. To be eligible for the study, participants had to report current regular use of a dietary supplement (at least once a week for the past year) and allow home visits with a study interviewer. Because participants were asked to record supplement purchases, those who were cognitively impaired or illiterate (as evaluated by a caregiver or by the interviewer) were deemed ineligible. All participants provided written informed consent. The study was approved by the Institutional Review Boards at the University of Hawaii and the University of Southern California.

Statistical Analysis

Statistical analyses were conducted using SAS (version 9.1, 2002, SAS Institute, Cary, NC). Fisher's exact test (20) was used to statistically compare supplement use across ethnic categories within sex. The median test (20) was used to identify significant differences in daily nutrient intakes among ethnic groups within sex.

RESULTS

Of the 1,073 multiethnic cohort participants who were contacted by telephone and eligible for the SURE study, 443 (43%) agreed to enroll in the study. Response rates varied across ethnic groups from 27% for Japanese Americans to 47% for African Americans, and was lowest for Latino men born outside the United States (20%). Attri-