Antioxidant Supplements Reported in the National Health and Nutrition Examination Survey (NHANES) 99-00

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Abstract

Oxidative injury is considered one of the initiators of cancer development. A large number of supplements containing antioxidant constituents are available in the marketplace to promote health and ostensibly to prevent the risk of various cancers. This study investigated the use of dietary supplements containing antioxidants in NHANES 1999-2000. Products were defined as antioxidant-containing supplements if they contained at least one of the following ingredients: vitamins C or E, beta-carotene, selenium, flavonoids or isoflavones. NHANES data files were imported into MS Access. Queries were constructed using Structured Query Language (SQL) to search dietary supplements containing any of these antioxidants. The number of respondents and weighted frequency of use were summed using SQL. Among the 1900 reported supplement products, more than 900 products (47%) contained at least one of the above antioxidants. A total of more than 3000 survey respondents, representing about 37% of US population, reported taking at least one of these products. Vitamins C and E were the top 2 reported antioxidant ingredients. Approximately 680 products containing Vitamin C were reported by more than 2900 respondents and 560 products containing Vitamin E were reported by about 2800 respondents. Other commonly reported antioxidants in rank order were selenium, beta-carotene, and flavonoids, which were present in about 280, 260 and 150 of reported products, respectively. Generally, more than 50% of respondents who reported taking multivitamins, took multivitamins containing Vitamins C or E at 100% Daily Value (DV) levels, which are the reference daily amounts, based on a 2000 calorie diet, that are used on supplement product labels. Only about 30 products containing isoflavones were reported by 40 respondents. Vitamins C and E and beta-carotene are the high priority vitamins being evaluated in pilot studies for the development of the DSID.

Objectives

- To analyze antioxidant ingredients in dietary supplements reported in NHANES 99-00
- To analyze U.S. consumption of antioxidant-containing supplements

Introduction

Epidemiological studies indicate that a high consumption of fruits and vegetables, which are rich in antioxidants, is associated with a lower risk of cancer (1). A large number of supplements containing antioxidant constituents are available in the marketplace. According to the NHANES dietary supplement questionnaire (DSQ) (2) data files, over 1900 dietary supplements were reportedly taken by about half of the U. S. population. Of the reported dietary supplements, multivitamin products were the most frequently used supplements.

As part of the Dietary Supplement Ingredient Database (DSID) working group, the Nutrient Data Laboratory, U.S. Department of Agriculture is working with the Office of Dietary Supplements, National Institutes of Health, and the National Center for Health Statistics, Center for Disease Control and Prevention, to develop a validated database for dietary supplements. This database will report the results of a systematic survey of dietary supplement composition based on chemical analyses of individual ingredients in supplements. In the early stages of this project, nutrient label values and information about the frequency of use of specific dietary supplements were obtained from the NHANES 99-00. The DSID working group prioritized supplement nutrients using a series of weighted factors, including exposure, research interest, measurement capabilities and public health importance (3). In this study, antioxidant-containing dietary supplements reported in the NHANES were identified and their consumption investigated.

Methods and Materials

NHANES 1999-2000 dietary supplement questionnaire data files and demographics file were imported into MS Access. In the NHANES data file, each product reported is linked to individual survey respondents who statistically represent a portion of the population. Nationally representative prevalence was estimated using person-level sampling weights to account for differential probabilities of selection and nonresponse, poststratified to US Census Bureau population estimates. Products were determined to be antioxidant-containing supplements if they contained at least one of the following ingredients: vitamins C or E, beta-carotene, selenium, flavonoids or isoflavones. For many antioxidants, there are different names listed in the NHANES data file. The following table lists the search words used to obtain complete information. The definitions used in this study for the terms antioxidant, flavonoids and isoflavones and the synonyms used for vitamins E or C, beta-carotene, and selenium were obtained from the Natural Medicines Comprehensive Database(4). The NHANES supplement ingredients and blend components tables were searched for all the terms listed below using Structured Query Language (SQL) queries. Numbers of respondents and weighted frequencies of use for all antioxidant-containing dietary supplements were summed. In addition, multivitamins (dietary supplements containing 3 or more vitamins) were also evaluated in this study. Antioxidant vitamins C or E were searched in multivitamins and their %DV levels vs. their consumption were summed.

Table: Key Words Searched in NHANES DSQ 99-00 to Obtain Antioxidant-Containing Supplements

Nutrient	Key Words
Antioxidants	Antioxidants, Vitamin C, Vitamin E, Beta-carotene, Anthocyanin, Proanthocyanidins, Anthocyanidins, Riboflavin, Selenium, Glutathione, Superoxide Dismutase, Bioflavonoids as Flavanones, Naringenin, Eriocitrin, Quercetin, Rutin, Hesperidin, Pine Bark
Flavonoids	Bioflavonoids, Anthocyanidins, Vitamin P, Eriodictyol, Hesperetin, Hesperidin, Quercetin, Quercetrin, Rutin, Pco (Proanthocyanidins), Polyphenols, Diosmin, Hesperidin, Flavonols, Kaempferol, Myricetin, Isorhamnetin Flavones
Isoflavones	Isoflavones, Soy, SoYa Phytoestrogen, Plant Estrogen, Daidzein, Genistein, Glycitein, Red Clover
Vitamin E	Vitamin E, Tocopherol
Vitamin C	Vitamin C, Ascorbic Acid
Beta-carotene	Beta-Carotene
Selenium	Selenium

Results and Discussion

Among the 1900 supplement products reported, more than 900 (47%) contained at least one of the above antioxidants. A total of more than 3000 survey respondents, representing about 37% of US population, reported taking at least one of these products. Vitamins C and E were the top 2 reported antioxidant ingredients. Approximately 680 products containing Vitamin C were reported by more than 2900 respondents and 560 products containing Vitamin E were reported by about 2800 respondents. Other commonly reported antioxidants in rank order were selenium, beta-carotene, and flavonoids, which were present in about 280, 260 and 150 products, respectively. Only about 30 products containing isoflavones were reported by 40 respondents. Figure 1 shows the total number of reported supplements containing antioxidants from NHANES 99-00. Figure 2 shows the weighted frequency, which represents U.S. population use of antioxidant-containing supplements.

More than 50% of respondents who reported taking multivitamins took multivitamins containing Vitamin C or E at 100% Daily Value (DV) levels. Figures 3 and 4 show that for multivitamins containing Vitamins E and C, approximately 54% and 61% of the population respectively (weighted frequency) reported taking a product with a labeled level of 100% DV.

Results and Discussion

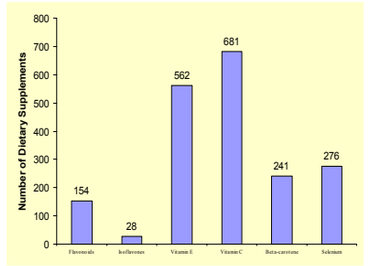

Figure1: Number of Supplements Containing Antioxidants NHANES 99-00 (n=910)

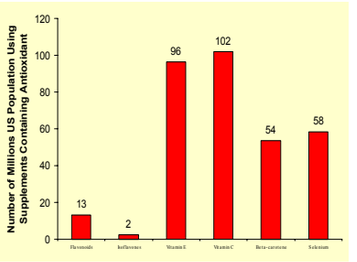

Figure2: Weighted Frequency (represents US population) of Use of Antioxidant-containing Dietary Supplements NHANES 99-00.

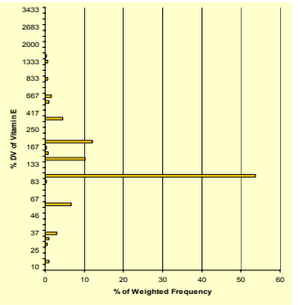

Figure 3: % DV of Vitamin E in Multivitamin Supplements Containing Vitamin E in NHANES 99-00 (n=434)

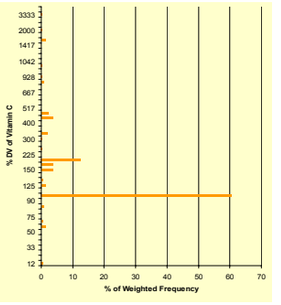

Figure 4: % DV of Vitamin C in Multivitamin Supplements Containing Vitamin C in NHANES 99-00 (n=447)

Future Plans

Antioxidant vitamins C, E and Beta-carotene, as well as the mineral selenium are high priority nutrients being evaluated in pilot studies for the development of the DSID. Laboratory methods and protocols for the analysis of vitamin and minerals in multivitamin products are currently being evaluated. Representative multivitamin products at the most common %DV levels will be analyzed to estimate the mean composition of high priority nutrients and to determine the variability among different products labeled at the same level. The subsequent study will analyze high priority nutrients in representative multivitamin products to determine actual levels

References

1. Weisburger JH. Nutritional Approach to Cancer Prevention with Emphasis on Vitamins, Antioxidants and Carotenoids. Am J Clin Nutr 1991; 53: S226-S237
2. http://www.cdc.gov/nchs/nhanes/ Accessed May 2004
3. Johanna T. Dwyer, Mary Frances Picciano, Joseph M. Betz, et. al. Progress in Development of an Integrated Dietary Supplement Ingredient Database at the NIH Office of Dietary Supplements. Journal of Food Composition Analysis (in press)
4. http://www.naturaldatabase.com/ Accessed May 2004