Table 2. Serum biomarker levels of long-term users of multiple dietary supplements (Multi Supp), multivitamin users (Single Supp), and nonusers (No Supp).

BIOMARKERS	No Supp	Single Supp	Multi Supp
Homocysteine (µmol/L)	9.6	9.1	6.1
C-reactive protein (mg/L)	4.6	3.2	1.9
Total cholesterol (mg/dL)	211.5	212.1	203.1
LDL cholesterol (mg/dL)	125.1	129.5	122.1
HDL cholesterol (mg/dL)	50.9	53.3	57.5
Ratio: total cholesterol to HDL-C	4.5	4.3	4.0
Triglycerides (mg/dL)	180.1	145.3	121.0

*Differences in biomarker concentrations among user groups were adjusted for sex, age, education, income, and body mass index.

Conclusions

Long-term multiple dietary supplement users were found to consume a broad array of vitamin/mineral, botanical, and condition-specific dietary supplements on a daily basis. They were more likely to have optimal concentrations of chronic disease-related biomarkers including serum homocysteine, C-reactive protein, high-density lipoprotein cholesterol, and triglycerides, and less likely to have suboptimal blood nutrient concentrations including folate, vitamin C, alpha and beta carotene, and vitamin E. **In general, disease prevalence was lower in multiple dietary supplement users as compared to single multivitamin users and nonusers. After adjusting for potential confounding variables, long-term supplement users also had a lower risk of elevated blood pressure and diabetes compared to nonusers.**

This study is the first to describe the usage patterns of long-term users of multiple dietary supplements, an unusual sample that is difficult to capture in national surveys. Thus, this snapshot of the nutrient and health correlates of this practice may serve as a springboard for other researchers to study this growing segment of the population who seek long-term health benefits through long-term use of multiple dietary supplements.

Study Limitations

A limitation of the study is that the data are cross-sectional, and therefore the reported associations, particularly with health outcomes (i.e., blood pressure and diabetes), cannot presume causality. In addition, although the investigators adjusted for potential confounders such as age, sex, income, education, and body mass index, residual confounding could possibly account for the study findings. Finally, although compelling in their support for the health benefits of supplementation, the study findings need to be confirmed. Further research into the dietary supplement usage patterns, health, and nutritional status of other groups of long-term users of broad arrays of dietary supplements is warranted.

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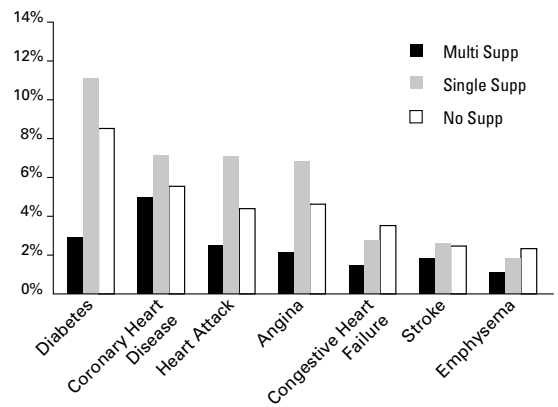
Usage Patterns, Health, and Nutritional Status of Long-Term Multiple Dietary Supplement Users

Introduction

Dietary supplement use in the United States is widespread and represents an important source of nutrition. But little is known about individuals who routinely consume multiple dietary supplements. This study was undertaken to describe the dietary supplement usage patterns, health, and nutritional status of long-term multiple dietary supplement users (Multi Supp) and makes comparisons to nonusers (No Supp) and multivitamin supplement users (Single Supp).

Long-term dietary supplement use was consistently associated with more favorable blood levels of measured nutrients and key heart health biomarkers. In general, disease prevalence was lower in Multi Supp users as compared to Single Supp and No Supp users (Graph 1). In addition, when researchers controlled for differences between groups in variables such as age, sex, education, income, and body mass index, they found the risk of diabetes was 73% lower and the risk of elevated blood pressure was 39% lower in Multi Supp users than in No Supp users. Also, Multi Supp users were four times more likely to describe their health as "very good" or "excellent" compared to No Supp users.

Graph 1. Disease prevalence in long-term users of multiple dietary supplements (Multi Supp), multivitamin users (Single Supp), and nonusers (No Supp).



Background

Diet and nutrition have long been thought to play key roles in achieving and maintaining optimal health and prevention of disease [1,2]. Vitamin/mineral supplements often provide 100% or more of the Daily Value of one or more essential nutrients and are widely used. Therefore, vitamin and mineral supplements are a key source of essential nutrients and may be key factors in health outcomes [3,4]. Dietary supplements, including varied antioxidant and phytonutrient ingredients, are also taken by an increasing number of health-conscious consumers in support of their commitment to achieve optimal health.

In recent reporting of data from the largest and longest-running national health and nutrition survey, known as the National Health and Nutrition Examination Survey (NHANES) 1999–2000 and sponsored by the Centers for Disease Control and Prevention, dietary supplement usage increased with age, education, and affluence, and was more common in women, and in whites [4]. Fifty-two percent of adults reported use of dietary supplements and 47% reported taking just one type of supplement, usually a multivitamin/mineral [4]. Although users of multiple dietary supplements appear to be a growing population, they appear to be under studied as little, if any, descriptive information has been reported about them [4]. In fact, only three of 11,000 NHANES participants reported the use of 20 or more different dietary supplements in the past 30 days.

The Study

The study objectives were to describe the dietary supplement usage patterns, health, and nutritional status of long-term multiple dietary supplement users, and to make appropriate comparisons to matched single multivitamin supplement users and nonusers. Gladys Block, Ph.D., renowned researcher and Professor of Epidemiology and Public Health Nutrition at the University of California, Berkeley, School of Public Health, helped lead the research team in its efforts to conduct the first-of-its-kind study on a unique population of long-term users of a broad array of a single brand of dietary supplements.

Methods

Using a cross-sectional study design, researchers obtained information from online questionnaires and on-site physical examinations from a sample of long-term users (Multi Supp users, n=278) of multiple dietary supplements that were manufactured by Shaklee Corporation, Pleasanton, CA. Within the Multi Supp group, 87% of users reported having taken 20 or more different supplements daily and usage began at least 20 years ago. Data for matched nonusers (No Supp users, n=602) and single multivitamin supplement users (Single Supp users, n=176) were obtained from NHANES 2001–2002 and NHANES III 1988–1994.

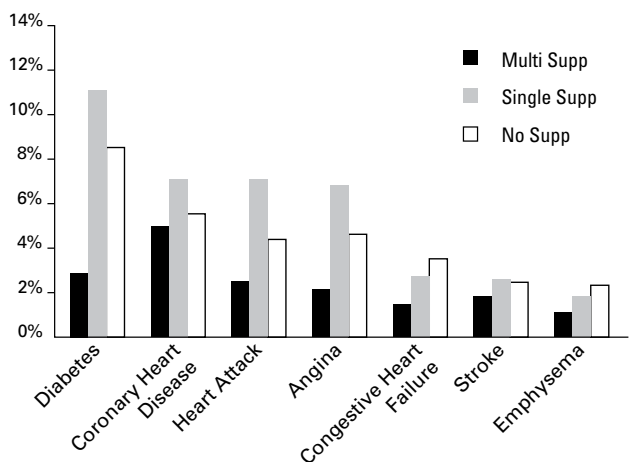
Results

Dietary supplements consumed on a daily basis by more than 50% of Multi Supp users included a multivitamin/mineral, vitamin B-complex, vitamin C, carotenoids, calcium with vitamin D, omega-3 fatty acids, flavonoids, glucosamine, an herbal immune supplement, a probiotic supplement (women), and a soy protein supplement (men).

Risk of Prevalent Disease

In general, disease prevalence was lower in Multi Supp users, as compared to single multivitamin users and nonusers (Graph 1). In addition, when researchers controlled for differences between groups in variables such as age, sex, education, income, and body mass index, they found the risk of diabetes was 73% lower and the risk of elevated blood pressure was 39% lower in Multi Supp users than in No Supp users and that Multi Supp users were four times more likely to describe their health as "very good" or "excellent" compared to No Supp users.

Graph 1. Disease prevalence in long-term users of multiple dietary supplements (Multi Supp), multivitamin users (Single Supp), and nonusers (No Supp).



Blood Nutrients

Blood nutrient levels generally increased with increasing dietary supplement use. Nutrients including folate, vitamin C, alpha and beta carotene, and vitamin E were consistently found at higher blood levels in the Multi Supp population (Table 1). To address the safety of long-term use of a broad array of supplements, the investigators also found healthy and safe blood levels of vitamin D and iron, nutrients for which high intakes have been associated with possible adverse effects. For example, among women, serum ferritin, a measure of iron storage, was highest in the Multi Supp group but lowest in male Multi Supp users compared to the two other groups.

Table 1. Serum nutrient levels of long-term users of multiple dietary supplements (Multi Supp), multivitamin users (Single Supp), and nonusers (No Supp).

NUTRIENTS	No Supp	Single Supp	Multi Supp
RBC folate (nmol/L)	646.7	891.1	1153.4
Retinol (µg/dL)	59.2	64.3	65.0
Ascorbic acid (mg/dL)	0.66	0.94	1.62
Alpha tocopherol (mg/dL)	1.1	1.4	2.9
Alpha carotene (µg/dL)	4.5	5.9	27.5
Beta carotene (µg/dL)	18.5	27.0	62.7
Ferritin (µg/L) Male	198.2	205.2	117.6
Ferritin (µg/L) Female	101.7	74.9	117.4

* Differences in nutrient concentrations among user groups were adjusted for sex and age.

Blood Biomarkers

Multi Supp users had higher blood levels of HDL cholesterol and lower blood levels of triglycerides, both consistent with lower heart disease risk. Increased supplement use was also associated with more favorable concentrations of serum homocysteine and C-reactive protein (CRP), a marker of low-grade inflammation (Table 2). Of note, none of the 278 Multi Supp study participants had an elevated CRP level (>3.0 mg/L), identified as "high risk" by the American Heart Association.