Trends in Dietary Supplement Use among US Adults From 1999–2012

Elizabeth D. Kantor, PhD[1,*], **Colin D. Rehm, PhD**[2,*], **Mengmeng Du, ScD**[1,3], **Emily White, PhD**[3,4], and **Edward L. Giovannucci, MD, ScD**[5,6]

[1]Department of Epidemiology and Biostatistics, Memorial Sloan Kettering Cancer Center, New York, NY, USA

[2]Office of Community and Population Health, Montefiore Medical Center, Bronx, NY, USA

[3]Division of Public Health Sciences, Fred Hutchinson Cancer Research Center, Seattle, WA, USA

[4]Department of Epidemiology, University of Washington School of Public Health, Seattle, WA, USA

[5]Departments of Nutrition and Epidemiology, Harvard T.H. Chan School of Public Health, Boston, MA, USA

[6]Channing Division of Network Medicine, Brigham and Women's Hospital, Boston, MA, USA

Abstract

Importance—Dietary supplements are commonly used by US adults; yet, little is known about recent trends in supplement use.

Objective—To report trends in dietary supplement use among US adults.

Design, Setting, and Participants—Temporal trends in supplement use were evaluated using nationally representative data from the National Health and Nutrition Examination Survey (NHANES) collected between 1999 and 2012. Participants include non-institutionalized adults residing in the US, surveyed over 7 continuous 2-year cycles (sample size per cycle ranged from 4,863 to 6,213).

Exposures—Calendar time, as represented by NHANES cycle.

Main Outcomes/Measures—In an in-home interview, participants were queried on use of supplements in the 30 days prior. This information was used to estimate the prevalence of use within each NHANES cycle, and trends were evaluated across cycles. Results are presented for use of any supplements, use of multivitamins/multiminerals (MVMM), as defined by a product containing 10 vitamins and/or minerals, as well as use of individual vitamins, minerals, and non-vitamin, non-mineral supplements. Results are presented overall, and by population subgroup, including age, sex, race/ethnicity, and educational status. All analyses are weighted to be nationally representative.

Corresponding Author: Elizabeth D. Kantor, PhD, MPH, Memorial Sloan Kettering Cancer Center, Department of Epidemiology and Biostatistics, 485 Lexington Avenue, 2nd Floor, New York, NY, 10017, kantore@mskcc.org, Phone: 646.888.8247, Fax: 929.321.1516.
*Denotes shared first authorship

Results—A total of 37,958 adults were included in the study [weighted mean age, 46.4 years, 52.0% women], with an overall response rate of 74%. Overall, use of supplements remained stable between 1999 and 2012, with 52% of US adults reporting use of any supplements in 2011–2012 (p-trend:0.19). This trend varied by population subgroup. Use of MVMM decreased, with 37% reporting use of MVMM in 1999–2000 and 31% reporting use in 2011–2012 (difference: −5.7%; 95% CI: −8.6%, −2.7%; p-trend<0.001). Vitamin D supplementation from sources other than MVMM increased from 5.1% to 19% (difference: 14%; 95% CI: 12%, 17%; p-trend<0.001) and use of fish oil supplements increased from 1.3% to 12% (difference: 11%; 95% CI: 9.1%, 12%; p-trend<0.001) over the study period, while use of a number of supplements decreased.

Conclusions and Relevance—Among adults in the United States, overall use of dietary supplements remained stable from 1999–2012, use of MVMM decreased, and trends in use of individual supplements varied and were heterogeneous by population subgroups.

INTRODUCTION

Dietary supplement products are commonly used by adults in the United States, with prior research indicating an increase in use between the 1980s and mid-2000s.[1,2] Although often taken to improve or maintain health, less than a quarter of all supplement products used are taken at the recommendation of a healthcare provider.[3] Instead, their use may be motivated, in part, by evidence suggesting that increased intake of some dietary constituents may be associated with reduced risk of outcomes, including cancer and cardiovascular disease (CVD).[4,5] Even so, results from observational studies have yielded mixed results regarding the health benefits of individual supplements or multivitamins/multiminerals (MVMM), and randomized controlled trials (RCTs) have often not supported benefits of these supplements, although the duration of many RCTs may have been insufficient to observe beneficial effects.[6–10] Furthermore, some research has indicated that use of selected supplements at high doses may have adverse effects,[11] generating some skepticism regarding their use.[12]

Despite extensive research conducted on the role of dietary supplements in health, little is known about recent trends in supplement use. Most studies describing patterns of use are restricted to older adults, focus on select supplements, are unable to evaluate temporal trends, or do not capture use in the last decade.[1,2,13,14] Using data from the National Health and Nutrition Examination Survey (NHANES), this paper therefore seeks to quantify trends in supplement use among US adults from 1999 to 2012, with a focus on use of any supplement products and MVMM, as defined by use of any products containing 10 vitamins and/or minerals, as well as use of individual vitamins, minerals, and non-vitamin, non-mineral (NVNM) supplements.

METHODS

Study Population

This study was conducted using data from NHANES, a nationally representative, cross-sectional survey of civilian, non-institutionalized persons living in the United States.[15] This analysis includes 7 two-year cycles (1999–2000 to 2011–2012), with 1999–2000 representing the first cycle for which continuous data are available and 2011–2012 representing the most recent cycle for which data are available. Each cycle is an independent sample. Participants provided written informed consent and study procedures were approved by the National Center for Health Statistic's Research Ethics Review Board. The Memorial Sloan Kettering Cancer Center Institutional Review Board determined that this analysis does not constitute human subjects research, and does not need human subjects approval.

Supplement Use

NHANES participants were first asked if they used any prescription or non-prescription supplements in the prior 30 days. Persons indicating use were asked to show the interviewer the bottles of each supplement product taken (77.4% of supplement products were seen): a supplement product could be a capsule, tablet, pill, softgel, chew/gummy or other product containing one or more supplements. When containers were not seen, participants were asked to recall each product taken. By linking to databases of supplement products and supplement product blends, use of MVMM, vitamins, minerals, and specific supplements was ascertained. More detail has been provided in NHANES documentation,[16] and detailed information on how this information was used in analysis is provided in the Supplementary Methods.

From this information, variables were created for use of any supplement product in the prior 30 days, use of ≥4 supplement products, as well as use of any vitamin, any mineral, and use of MVMM (defined as a product containing ≥10 vitamins and/or minerals).[17] This definition was created to capture products labeled as multivitamins in the market place (i.e., supplements used by consumers as a non-specific dietary supplement, commonly containing the recommended daily values of multiple vitamins, and typically including minerals, as well). However, this definition did not require any minerals to be in the formulation because several of the most popular multivitamin brands during the period of the surveys did not have minerals. The cutoff of 10 vitamins and/or minerals was used to separate common MVMMs from more specialized supplements such as B-complex supplements and supplements developed for eye and bone health. However, to allow for comparison to prior NHANES analyses, a secondary MVMM variable, defined as products containing ≥3 vitamins and ≥1 mineral, is also presented.[3]

Variables were also created corresponding to individual vitamins, minerals, and NVNM supplements. To distinguish how supplements are consumed, results are presented both overall (i.e., any use) and exclusive of MVMM supplements (e.g., vitamin D not from MVMM). This is important because supplements consumed as part of MVMM are often consumed at lower doses than they are in individual or focused combination supplements,

and because understanding how supplements are consumed can help inform our understanding of trends. Primary analyses focus on any use during the prior 30 days.

Statistical Analyses

The prevalence of supplement use, as determined by use in the prior 30 days, was assessed within each NHANES cycle. Survey-weighted logistic regression was used to calculate a P-trend across cycles; the statistical significance of trends was evaluated using a two-sided test at the α=0.05 level. Ratios for the prevalence of use in 2011–2012 vs. 1999–2000 are presented; in the presentation of results, a 'decrease' corresponds to a ratio<1 and p-trend<0.05, an 'increase' represents a ratio>1 and p-trend<0.05, and 'stable' represents a p-trend 0.05. Differences, representing the absolute difference in the prevalence of use in 2011–2012 vs. 1999–2000, are also presented.

Because most supplemental vitamins/minerals are consumed in the form of MVMM and total use was of most interest, trends in main tables are shown for total supplement use. However, results are also presented exclusive of MVMM if the trends with and without MVMM markedly varied. Detailed trends, both overall and exclusive of MVMM, are provided in supplementary tables. Throughout the text, the discussion of trends refers to overall trends in any use of a given dietary supplement (regardless of whether consumed as part of a MVMM), unless otherwise noted.

As data are presented on a large number of supplements, the discussion focuses on supplements fitting the following criteria: i) a high prevalence of use (>10% during any cycle), and ii) a large change in use over the study period (>3-fold change). Given potential heterogeneity by population subgroup, results are presented by age (20–39y, 40–64y, 65y), sex, self-reported race/ethnicity (non-Hispanic white, non-Hispanic black, Mexican-American), and education (highest attained degree: <high school, high school/some college, 4-year college)

Sensitivity analyses are presented for regular use (defined as use 15 days/month) and age-adjusted trends. To address whether the trends were consistent over the study period, joinpoint regression analyses were conducted and the annual percentage change (APC) before and after potential inflection points were calculated using Joinpoint Regression Program Software (version 4.2.0, National Cancer Institute).[18]

NHANES is a stratified, complex, multistage probability-based survey that oversamples certain groups, and as such, all participants are assigned analytic weights to account for their unequal sampling probability and non-response. Analyses were conducted using Stata 13.1 (College Station, TX).

RESULTS

Over these 7 NHANES cycles, 38,024 adults aged 20y completed an in-home interview, where supplement use was ascertained. Sixty-six persons were excluded due to missing information on supplement use, leaving 37,958 persons (sample size per cycle: 4,863–

6,213). The response rate was 73.6%, with the cycle-specific response rate ranging from 67.4%–78.3%.[19]

In 2011–2012, 52% (95% CI:49%, 55%) of US adults reported using any supplement product in the prior 30 days (Table 1). Supplement use was associated with several socio-demographic variables. For example, supplement use increased with age, with 72% of adults ages 65+ reporting use (95% CI: 69%, 75%), as compared to 40% of adults ages 20–39 (95% CI: 35%, 45%). Women (58%; 95% CI: 55%, 62%) were also more likely to use supplements than men (45%; 95% CI: 42%, 49%). Use was highest among non-Hispanic whites (58%; 95% CI: 55%, 62%), and lowest among Mexican-Americans (29%; 95% CI: 25%, 33%). There was an educational gradient, with use highest among the most highly educated: 65% (95% CI: 61%, 69%) of those with 4-year college degree reported use, as compared to 37% (95% CI: 34%, 40%) of those with <a high school degree.

Overall, there was no change in overall supplement use, with 52% reporting use in 1999–2000 and in 2011–2012 (difference:0.0%; 95% CI: −3.6%, 3.6%) (Table 2). There was also no change in use of 4 supplement products, with 9.9% reporting use of 4 supplement products in 2011–2012 (difference:1.1%; 95% CI: −0.8%, 3.0%). However, use of MVMM, as defined by a product containing 10 vitamins and/or minerals, decreased from 37% to 31% (difference: −5.7%; 95% CI: −8.6%, −2.7%). The trend in MVMM use also significantly decreased when alternatively defined by use of products containing 3 vitamins and 1 mineral, with use decreasing from 39% to 36% (difference: −3.6%; 95% CI: −6.8%, −0.4%). Use of any vitamin remained stable, with 48% (95% CI: 45%, 50%) reporting use in 2011–2012, although use of any vitamin, excluding MVMM, increased. Use of any mineral/element decreased from 42% to 39% (difference: −3.0%; 95% CI: −6.5%, 0.4%), although use of mineral/elements was stable when excluding MVMM.

There was a decrease in use of several vitamins and minerals overall (Table 2), including vitamin C, vitamin E, and selenium. The decreases in these supplements persisted when excluding MVMM (eTable 1). Although use of most vitamins and minerals decreased, this was not universal. For example, vitamin D, the most commonly used vitamin in 2011–2012, remained stable overall; however, use excluding MVMM increased almost 4-fold (5.1% to 19%; difference:14%; 95% CI:12%, 17%). Use of lycopene-containing supplements (mostly MVMM) increased almost 9-fold (1.9% to 16% among men; difference:14%; 95% CI:12%, 16%); use of lycopene also increased among women, although use was markedly lower than among men.

Use of several NVNM supplements increased (Table 3; eTable 2). Omega-3 fatty acids increased almost 7-fold, with 1.9% of adults reporting use in 1999–2000 and 13% in 2011–2012 (difference:11%; 95% CI:9.4%, 13%). Omega-3 fatty acids were the most commonly used NVNM in 2011–2012. This trend was primarily driven by the 9-fold increase in fish oil (1.3% to 12%; difference:11%; 95% CI:9.1%, 12%), although use of alpha-linolenic acid/flaxseed also increased. Omega-6 and omega-9 fatty acid supplement use increased, as did use of co-enzyme Q10, cranberry, green tea/epigallocatechin gallate (EGCG), methylsulfonylmethane (MSM), and probiotics.

Use of Echinacea decreased, as did use of garlic, gingko biloba, ginseng, and para-aminobenzoic acid (PABA). Use of glucosamine and chondroitin did not significantly change, nor did use of amino acids or fiber.

Trends by age, sex, race/ethnicity, and education were also evaluated (eTables 3–6). Any supplement use decreased among adults ages 20–39y, was stable among ages 40–64y, and increased among adults ages 65+y (eTable 3; Figure 1). Although women reported more supplement use than men, trends were stable in both groups groups (eTable 4; Figure 1). Use of any supplements remained stable among non-Hispanic whites and Mexican-Americans, but increased among non-Hispanic blacks (eTable 5; Figure 1). Use of supplements remained stable among those with less than a high school education, but decreased among those in higher education groups (eTable 6; Figure 1).

The overall decrease in use of MVMM was largely driven by a decrease among adults ages 40–64y, with no change observed among older adults (eTable 3; eFigure 1). Use of MVMM decreased significantly among non-Hispanic whites, but remained stable among non-Hispanic blacks and Mexican-Americans (eTable 5; eFigure 1). Use of MVMM decreased for both men and women (eTable 4; eFigure 1) and for all education groups (eTable 6; eFigure 1).

Subgroup-specific estimates are presented in Figure 2 for the most commonly used vitamin/mineral, vitamin D, and in eFigure 2 for the most commonly used NVNM, fish oil. Use of vitamin D (exclusive of MVMM) and fish oil and increased in all population subgroups. However, when including MVMM, increased use of vitamin D was observed only in those aged ≥65y (eTable 3), females (eTable 4), and Non-Hispanic blacks (eTable 5). When exploring use among adult women of childbearing age (20–44y) (eTables 7–8), use of any supplement products and MVMM decreased. Use of folic acid-containing supplements decreased; however, use of folic acid exclusive of MVMM remained stable.

Trends were relatively comparable for regular use (eTable 9–10), and when adjusting for age (eTable 11).

No significant joinpoints were observed for overall supplement use or MVMM (eTable 12). However, a significant joinpoint, indicating a change in trend, was observed for a number of supplements. Most notably, lycopene increased dramatically prior to 2003–2004 (APC=130%; 95% CI:62%, 226%), decreasing thereafter (APC=−4.5%; 95% CI: −7.2%, −1.6%).

DISCUSSION

In this large, nationally representative survey of US adults, supplement use remained stable from 1999–2012, with 52% of adults reporting use of supplements in the prior 30 days in 1999–2000 and 2011–2012. Use of MVMM, as defined by a product containing ≥ 10 vitamins and/or minerals, decreased from 37% to 31%. Trends varied for individual supplements, and across age, sex, race/ethnicity, and education.

The stable trend in overall supplement use stands in contrast to earlier studies reporting their increase between the 1980s and early-2000s.[1,2] With the present data, it is clear that the use of supplements among US adults has stabilized. This stabilization appears to be the balance of several opposing trends, with a major contributing downward factor being the decrease in use of MVMM. This trend may reflect increased scrutiny of MVMM,[12] following several studies showing no benefit.[7,10,20] Furthermore, in the mid-to-late 2000s, several expert bodies released statements or recommendations concluding that there is either insufficient or no evidence to support use of MVMM or supplements to prevent chronic disease.[21–23] It is also possible that the economic downturn in the late 2000s may have also impacted trends in use. The Physicians' Health Study II RCT demonstrated that daily MVMM use modestly reduced total cancer incidence in men;[24] however, this study was published in 2012, and would not have influenced our findings.

Beyond the decrease for MVMM, a decrease was also observed in use of most vitamins and minerals, including antioxidants vitamins C, E, and selenium. These trends persisted when limited to non-MVMM supplements, indicating that these downward trends were not solely due to the decrease in MVMM use, but also to the decrease in use of individual or smaller combinations containing these antioxidants. This decrease likely reflects increasing skepticism regarding antioxidant supplements,[12] following the publication of studies which demonstrated no or adverse effects on various outcomes.[9,11,25–27]

Despite the decrease in MVMM and many vitamins/minerals, not all decreased. Although overall vitamin D supplement use remained stable, a marked increase in vitamin D supplement use exclusive of MVMM was observed. This indicates that this increase is not due to increased inclusion of vitamin D in MVMM supplements but rather to an increase in individual vitamin D supplements or more focused combinations. This increase aligns with a growing body of research evaluating the potential beneficial effects of vitamin D on a number of health outcomes, including fractures, cancer, CVD, and multiple sclerosis.[28–31] Such research likely increased public awareness about the potential benefits of vitamin D and testing for vitamin D insufficiency,[32] contributing to the increase observed here and in a recent study of older adults.[14]

Use of lycopene-containing supplements also increased. A significant joinpoint for lycopene use was observed in 2005–2006, at which time lycopene was used by 25% of men. This increase in the early 2000s followed well-publicized research suggesting that consumption of lycopene-rich tomato products was associated with reduced risk of prostate cancer.[4] This trend was almost entirely driven by MVMM; this increase was due to increased inclusion of lycopene in MVMM formulations, not increased use of individual lycopene supplements.

Use of omega-3 fatty acid-containing supplements also increased; this trend was largely driven by an increase in fish oil supplements, although an increase in alpha-linolenic acid/flaxseed was also observed. This increase, which has been observed previously,[13,14] likely reflects increased research and subsequent media attention for the potential benefits of fish/omega-3 fatty acid intake and fish oil supplements on risk of cancer and CVD.[5,33,34] The ongoing Vitamin D and Omega-3 Trial (VITAL), when complete, will provide valuable

information to guide consumers and health care providers regarding the effects of omega-3 fatty acids and vitamin D.[35]

Not all NVNM supplements increased; many remained stable and a decrease was observed for several, including those that were amongst the most popular in the early-2000s,[36] including ginseng, gingko, and garlic. The decline in gingko may be related to a 2002 RCT observing no effect of ginkgo on memory function, its primary indication.[37] Furthermore, while glucosamine and chondroitin remained stable, a significant joinpoint was observed in 2005–2006, after which use declined. This is likely due to the 2006 Glucosamine/Chondroitin Arthritis Intervention Trial, which found no effect of these supplements on joint structure/function.[8]

The trend in any supplement use varied by age, with use decreasing among young adults, stable among middle-aged adults, and increasing among older adults. Arecent study of adults ages 62–85y, which found that supplement use among older adults rose from 51.8% in 2005–2006 to 63.7% in 2010–2011;[14] an increase among older adults was also observed, but this increase does not hold for other age groups. Use of MVMM decreased significantly among non-Hispanic whites and more highly educated groups. The reasons for these patterns are unclear. It is possible that the difference in trends in MVMM use by age group may reflect a cohort effect, but a longer time frame would be needed to address this question. It is also possible that differences in trends by population subgroup reflect that research translates into behavior change more quickly in certain population subgroups,[38,39] although differences across subgroups also likely reflect underlying health status and socioeconomic differences.[3]

This study has several important strengths. This study was conducted using data from a large nationally representative survey. Supplement use was assessed during an in-home interview, in which participants provided detailed information on supplements used over the prior 30 days; supplement bottles were seen for the majority of supplements, likely increasing accuracy of exposure measurement. Furthermore, this data was collected as part of a continuous national survey, allowing for evaluation of trends over a 14-year period. Even so, the present study has important limitations. This is a study of the non-institutionalized, civilian population, and does not capture use among adults in nursing homes or the military. Furthermore, supplements were assessed in the prior 30 days, which may underestimate any use over the year prior for supplements that may vary seasonally, such as those commonly taken for colds; however, this would not influence our ability to detect trends in use over time. This analysis uses the most recently available data (available through 2011–2012), and it is unknown whether or how these findings reflect dietary supplement use at present. Furthermore, this manuscript focuses on any use in the prior 30 days, although sensitivity analyses do include evaluate trends in regular use of supplements. The analyses did not incorporate information on dose, as the intention was to assess prevalence of use in the population, rather than population-level exposure. It also did not incorporate information about adherence. Fifth, the serial cross-sectional study design precluded longitudunal measurement of supplement use within the same individuals.

Conclusions

Among adults in the United States, overall use of dietary supplements remained stable from 1999–2012, use of MVMM decreased, and trends in use of individual supplements varied and were heterogeneous by population subgroups.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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KEY POINTS

Question

As little is known about recent patterns in supplement use, this manuscript describes patterns of dietary supplement use among US adults from 1999–2012.

Findings

In the nationally representative National Health And Nutrition Examination Survey, use of any supplement products remained stable between 1999 and 2012, with 52% of US adults reporting use of any supplements in both 1999–2000 and 2011–2012. Patterns varied by individual supplements, and multivitamin/multimineral use decreased, with 37% reporting use in 1999–2000 and 31% reporting use in 2011–2012.

Meaning

While any use of dietary supplement products remained stable in recent years, patterns varied by individual supplements.
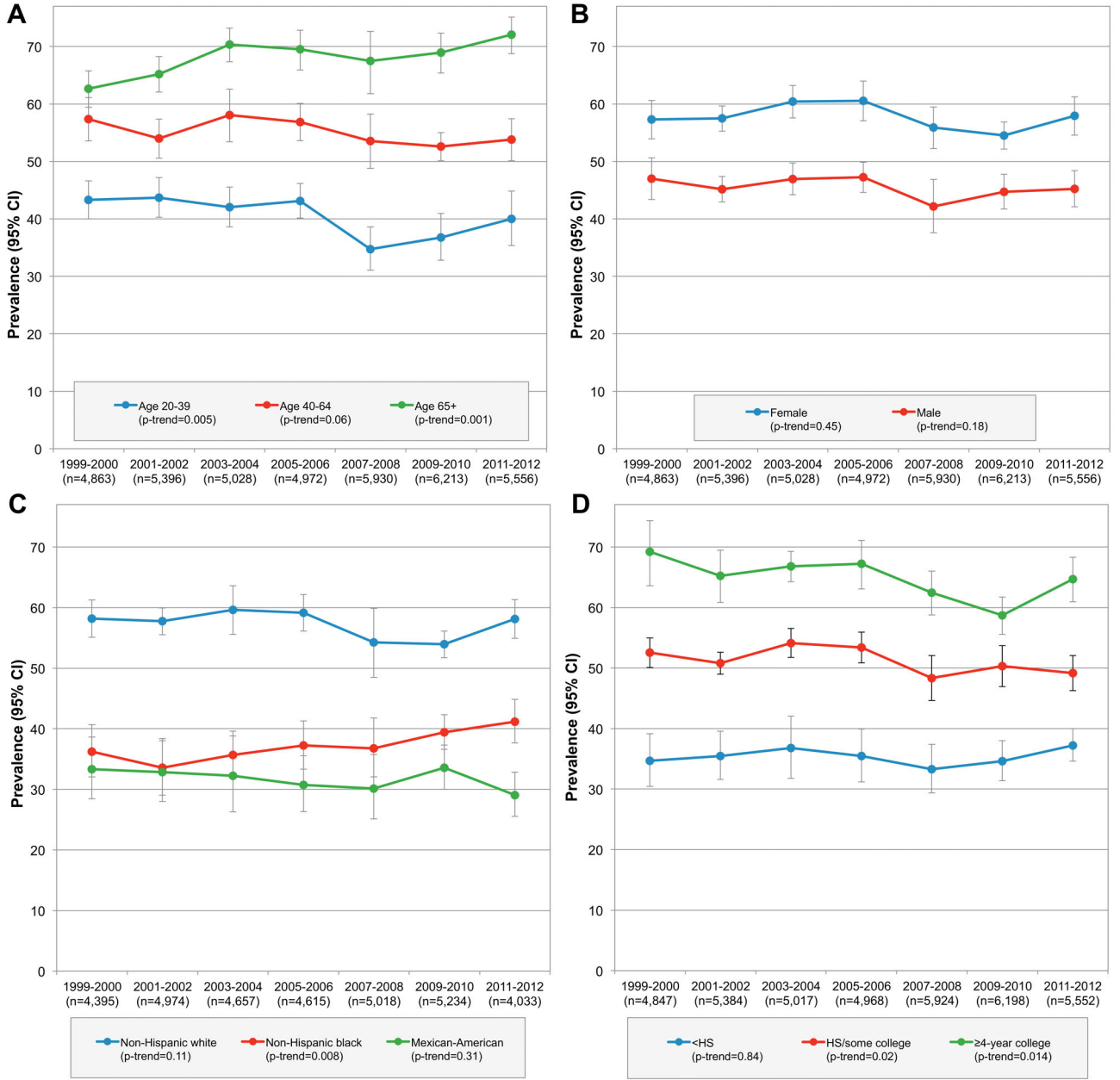
Figure 1.
Trends in Any Supplement Use, by Age, Sex, Race/Ethnicity, and Education
Abbreviations: HS (high school); MVMM (multivitamin/multimineral); data are weighted to be nationally representative.
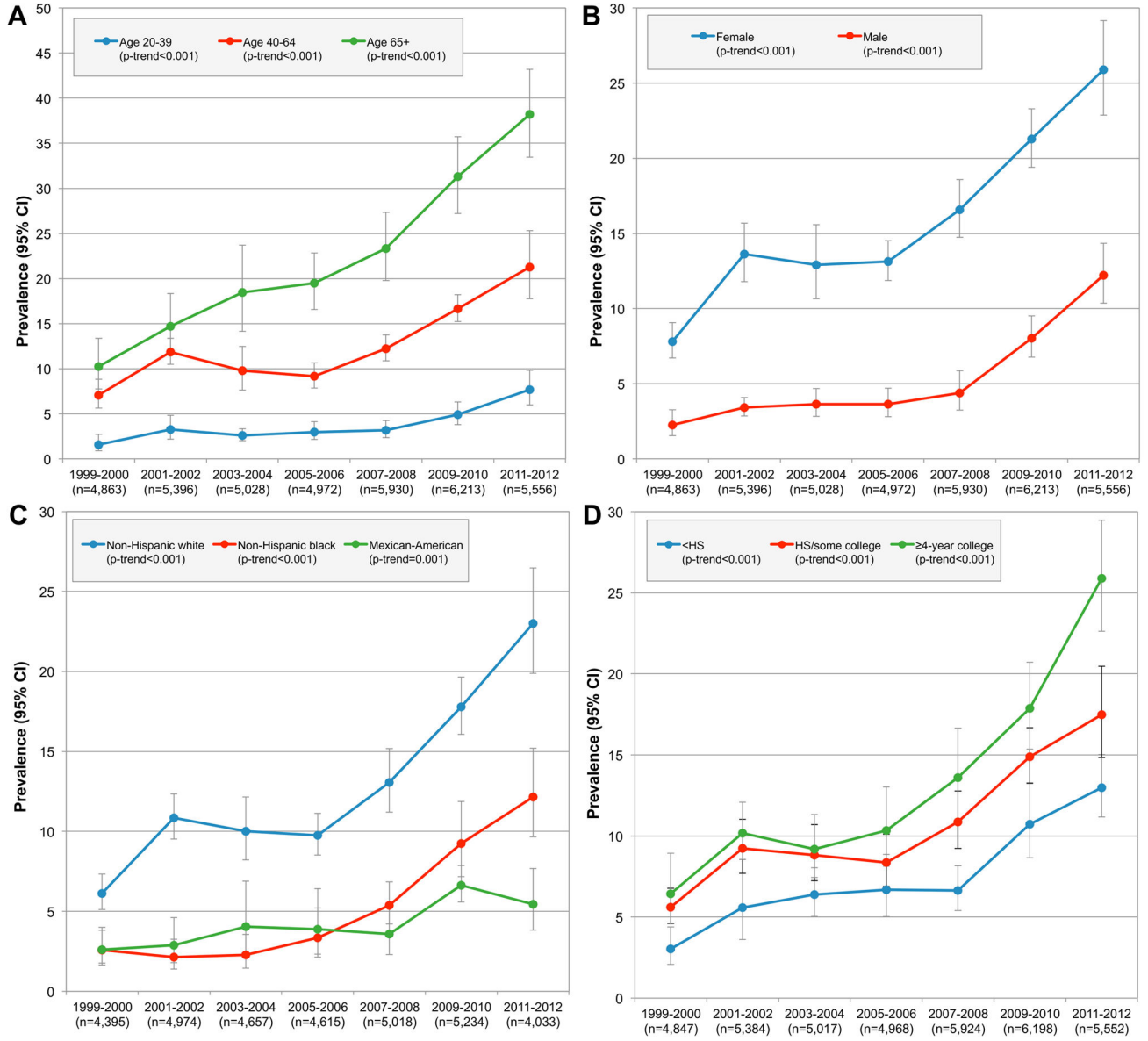
Figure 2.
Trends in Use of Vitamin D (Excluding MVMM), by Age, Sex, Race/Ethnicity, and Education

Abbreviations: HS (high school); MVMM (multivitamin/multimineral); data are weighted to be nationally representative.

Table 1

Supplement Use in Prior 30 Days Among US Adults,[a] by Population Characteristics: 2011–2012

		Any Supplement Use	
	N	**n**	**% (95% CI)[b]**
OVERALL	**5,556**	**2,715**	**52 (49, 55)**
Age group			
20–39	1,957	718	40 (35, 45)
40–64	2,352	1,171	54 (50, 58)
65	1,247	826	72 (69, 75)
Sex			
Female	2,819	1,548	58 (55, 62)
Male	2,737	1,167	45 (42, 49)
Race/ethnicity			
Non-Hispanic white	2,038	1,169	58 (55, 62)
Non-Hispanic black	1,455	640	41 (37, 45)
Mexican-American	540	177	29 (25, 33)
Other Hispanic	578	243	38 (33, 42)
Non-Hispanic Asian	793	404	52 (45, 58)
Other/mixed race	152	82	48 (41, 55)
Education			
<High school	1,330	510	37 (34, 40)
High school	1,168	511	46 (42, 50)
Some college	1,657	826	51 (47, 56)
4-year college	1,397	866	65 (61, 69)
Self-reported health status			
Excellent	470	251	61 (54, 67)
Very good	1278	707	58 (53, 62)
Good	1885	884	47 (43, 50)
Fair/Poor	1069	489	49 (43, 54)

[a]Among adults ages 20 years.

[b]Data are weighted to be nationally representative.

Table 2

Trends in Overall Supplement Use, as well as Use of MVMM, Vitamins and Minerals, and Common MVMM Components: US Adults,[a] 1999–2000 through 2011–2012[b,c]

	30-day prevalence of use % (95% confidence interval [CI])[d]							p-trend	2011–2012 vs 1999–2000	
	1999–2000 (n=4,863)	2001–2002 (n=5,396)	2003–2004 (n=5,028)	2005–2006 (n=4,972)	2007–2008 (n=5,930)	2009–2010 (n=6,213)	2011–2012 (n=5,556)		Ratio	Difference
SUMMARY USE										
Any supplement product	52 (49, 54)	51 (50, 53)	54 (51, 57)	54 (51, 56)	49 (45, 53)	50 (47, 52)	52 (49, 55)	.19	1.0 (0.93, 1.1)	0.0 (−3.6, 3.6)
Excluding MVMM	34 (32, 37)	34 (32, 36)	36 (33, 39)	36 (33, 38)	34 (31, 38)	34 (32, 36)	39 (36, 42)	.063	1.1 (1.0, 1.3)	5.0 (1.0, 8.9)
4 supplement products	8.7 (7.5, 10)	9.8 (8.3, 12)	10 (8.7, 12)	9.9 (8.5, 11)	9.0 (7.1, 11)	7.8 (6.8, 9.0)	9.9 (8.6, 11)	.60	1.1 (0.92, 1.4)	1.1 (−0.8, 3.0)
MVMM[e]	37 (35, 39)	38 (35, 40)	38 (36, 41)	40 (38, 42)	33 (30, 36)	32 (31, 34)	31 (29, 33)	<.001	0.85 (0.78, 0.92)	−5.7 (−8.6, −2.7)
MVMM (alternative definition)[f]	39 (37, 42)	40 (38, 42)	42 (40, 44)	43 (41, 45)	36 (33, 40)	37 (35, 38)	36 (34, 38)	<.001	0.91 (0.83, 0.99)	−3.6 (−6.8, −0.4)
Any vitamin	47 (44, 50)	47 (46, 49)	49 (46, 52)	49 (47, 51)	44 (41, 48)	45 (43, 47)	48 (45, 50)	.30	1.0 (0.94, 1.1)	0.8 (−3.1, 4.6)
Excluding MVMM	25 (23, 28)	27 (25, 28)	28 (25, 31)	26 (24, 28)	26 (23, 29)	26 (24, 28)	31 (28, 34)	.047	1.2 (1.1, 1.4)	5.7 (1.9, 9.5)
Any mineral/element	42 (39, 45)	43 (41, 45)	45 (43, 48)	46 (43, 49)	40 (36, 43)	39 (38, 41)	39 (37, 41)	<.001	0.93 (0.85, 1.0)	−3.0 (−6.5, 0.4)
Excluding MVMM	18 (16, 20)	20 (18, 22)	22 (20, 25)	20 (18, 22)	19 (16, 22)	17 (16, 18)	18 (17, 20)	.054	1.0 (0.89, 1.2)	0.3 (−2.0, 2.6)
INCREASED										
Lutein/zeaxanthin	8.5 (5.8, 12)	18 (17, 20)	22 (20, 24)	21 (20, 23)	18 (16, 20)	12 (11, 13)	10 (9.2, 12)	.019	1.2 (0.82, 1.8)	1.9 (−1.6, 5.3)
Lycopene (men only) *	1.9 (1.2, 2.9)	2.9 (2.3, 3.8)	21 (19, 24)	25 (23, 27)	22 (20, 26)	18 (16, 20)	16 (14, 18)	<.001	8.7 (5.5, 14)	14 (12, 16)
Vitamin B$_{12}$ (Cobalamin), Excluding MVMM *	5.7 (4.7, 6.8)	5.6 (4.8, 6.5)	5.9 (5.0, 7.0)	6.8 (5.6, 8.2)	6.8 (5.6, 8.3)	6.1 (5.5, 6.7)	8.1 (6.9, 9.5)	.002	1.4 (1.1, 1.8)	2.4 (0.8, 4.1)
Vitamin D, Excluding MVMM *	5.1 (4.3, 6.1)	8.7 (7.7, 9.9)	8.5 (7.1, 10)	8.6 (7.7, 9.6)	11 (9.4, 12)	15 (14, 16)	19 (17, 22)	<.001	3.8 (3.0, 4.6)	14 (12, 17)
DECREASED										
Boron	24 (22, 26)	25 (23, 27)	26 (23, 28)	25 (23, 27)	19 (17, 22)	20 (19, 21)	17 (16, 18)	<.001	0.7 (0.63, 0.78)	−7.2 (−9.6, −4.9)
Calcium *	38 (35, 41)	39 (37, 41)	42 (39, 45)	44 (41, 46)	36 (33, 40)	37 (35, 38)	35 (33, 37)	.002	0.93 (0.84, 1.0)	−2.8 (−6.2, 0.5)
Chromium	28 (26, 30)	30 (28, 32)	30 (28, 33)	32 (30, 34)	28 (25, 31)	28 (26, 30)	27 (25, 28)	.041	0.94 (0.84, 1.0)	−1.8 (−4.6, 1.0)
Copper	31 (28, 33)	31 (29, 33)	32 (30, 34)	34 (32, 36)	29 (26, 31)	29 (27, 31)	27 (25, 28)	<.001	0.87 (0.8, 0.96)	−3.8 (−6.5, −1.1)
Iodine	29 (27, 31)	29 (27, 31)	28 (26, 31)	28 (26, 31)	22 (20, 25)	22 (21, 24)	20 (18, 21)	<.001	0.68 (0.61, 0.75)	−9.4 (−11.9, −6.8)
Iron *	31 (27, 34)	29 (27, 30)	27 (25, 29)	27 (24, 30)	21 (19, 23)	21 (20, 22)	19 (17, 20)	<.001	0.61 (0.53, 0.7)	−12 (−15, −8.3)

	30-day prevalence of use % (95% confidence interval [CI])[d]								2011–2012 vs 1999–2000	
	1999–2000 (n=4,863)	2001–2002 (n=5,396)	2003–2004 (n=5,028)	2005–2006 (n=4,972)	2007–2008 (n=5,930)	2009–2010 (n=6,213)	2011–2012 (n=5,556)	p-trend	Ratio	Difference
Magnesium	33 (30, 35)	34 (32, 36)	35 (33, 38)	37 (35, 39)	31 (28, 34)	30 (29, 32)	28 (27, 30)	<.001	0.87 (0.79, 0.96)	−4.2 (−7.2, −1.1)
Manganese	28 (26, 31)	30 (28, 32)	31 (28, 33)	32 (30, 34)	28 (26, 31)	28 (26, 30)	26 (25, 27)	.009	0.91 (0.83, 1.0)	−2.5 (−5.1, 0.2)
Molybdenum	25 (23, 28)	27 (26, 29)	27 (25, 30)	26 (25, 28)	21 (18, 24)	21 (20, 23)	18 (17, 19)	<.001	0.71 (0.64, 0.79)	−7.4 (−9.8, −5.0)
Phosphorus	25 (23, 27)	24 (23, 26)	25 (22, 27)	23 (22, 25)	18 (16, 21)	18 (17, 20)	15 (14, 17)	<.001	0.61 (0.53, 0.7)	−9.6 (−12, −6.9)
Potassium	28 (26, 30)	28 (26, 30)	28 (26, 31)	28 (26, 30)	23 (20, 25)	22 (21, 24)	18 (16, 19)	<.001	0.63 (0.55, 0.71)	−10 (−13, −7.8)
Selenium*	28 (26, 31)	30 (28, 32)	30 (28, 33)	32 (30, 34)	28 (25, 31)	27 (26, 29)	26 (24, 27)	.002	0.9 (0.82, 0.99)	−2.8 (−5.4, −0.1)
Selenium Excluding MVMM*	2.6 (2.2, 3.2)	2.6 (2.1, 3.3)	2.1 (1.4, 3.1)	1.5 (1.2, 2)	1.1 (0.7, 1.6)	0.9 (0.6, 1.4)	0.7 (0.4, 1.2)	<.001	0.28 (0.16, 0.48)	−1.9 (−2.5, −1.3)
Vanadium	22 (20, 25)	22 (21, 24)	24 (21, 26)	23 (21, 25)	18 (16, 21)	18 (17, 20)	14 (13, 16)	<.001	0.65 (0.57, 0.74)	−7.9 (−10, −5.3)
Vitamin A*	36 (33, 38)	37 (35, 40)	37 (35, 40)	39 (37, 42)	33 (30, 36)	33 (31, 34)	31 (30, 33)	<.001	0.88 (0.81, 0.96)	−4.3 (−7.2, −1.4)
Vitamin B$_1$ (Thiamin)	37 (35, 40)	38 (36, 41)	38 (35, 41)	40 (38, 43)	33 (30, 36)	32 (31, 34)	30 (28, 32)	<.001	0.81 (0.74, 0.89)	−6.9 (−10, −3.8)
Vitamin B$_2$ (Riboflavin)	37 (35, 40)	38 (36, 40)	38 (35, 41)	40 (38, 43)	33 (30, 36)	32 (31, 34)	30 (28, 32)	<.001	0.82 (0.75, 0.9)	−6.8 (−9.9, −3.6)
Vitamin B$_3$ (Niacin)	37 (35, 40)	38 (36, 40)	38 (35, 41)	40 (38, 43)	34 (30, 37)	33 (31, 35)	31 (29, 33)	<.001	0.84 (0.76, 0.92)	−6.1 (−9.2, −2.9)
Vitamin B$_5$ (Pantothenic acid)	34 (32, 37)	36 (34, 38)	36 (33, 38)	38 (35, 40)	32 (29, 35)	31 (29, 33)	30 (28, 31)	<.001	0.87 (0.79, 0.96)	−4.5 (−7.5, −1.4)
Vitamin B$_6$ (Pyridoxine)	38 (36, 41)	39 (37, 41)	39 (37, 42)	41 (39, 44)	35 (32, 38)	34 (32, 36)	32 (30, 35)	<.001	0.85 (0.78, 0.93)	−5.6 (−8.8, −2.4)
Vitamin B$_9$ (Folic acid)	38 (35, 40)	38 (36, 41)	39 (36, 42)	41 (38, 44)	35 (32, 38)	34 (32, 36)	33 (30, 35)	<.001	0.87 (0.78, 0.95)	−5.1 (−8.5, −1.7)
Vitamin B$_{12}$ (Cobalamin)*	38 (35, 40)	39 (37, 41)	39 (36, 41)	41 (39, 44)	36 (32, 39)	35 (33, 37)	35 (33, 37)	.001	0.92 (0.85, 1.0)	−2.9 (−6.1, 0.2)
Vitamin C	42 (39, 44)	42 (40, 45)	43 (40, 46)	45 (42, 47)	38 (34, 41)	37 (35, 38)	36 (34, 38)	<.001	0.86 (0.79, 0.93)	−5.9 (−9.0, −2.8)
Vitamin E	41 (38, 43)	41 (40, 43)	42 (39, 45)	42 (40, 45)	35 (32, 38)	34 (32, 36)	34 (32, 36)	<.001	0.83 (0.76, 0.91)	−6.9 (−10, −3.6)
Zinc	35 (32, 38)	36 (34, 38)	37 (35, 39)	39 (37, 42)	32 (29, 35)	32 (30, 33)	30 (28, 32)	<.001	0.86 (0.78, 0.94)	−5.0 (−8.1, −1.8)
STABLE										
Biotin	30 (27, 32)	30 (28, 32)	31 (28, 34)	33 (31, 35)	29 (26, 33)	30 (28, 32)	29 (27, 31)	.51	0.98 (0.89, 1.1)	−0.5 (−3.5, 2.5)
Calcium, Excluding MVMM*	13 (12, 15)	15 (14, 17)	17 (15, 20)	16 (14, 18)	15 (12, 17)	13 (13, 14)	14 (12, 15)	.15	1.0 (0.86, 1.2)	0.4 (−1.9, 2.8)
Choline	5.1 (4, 6.3)	5.1 (4.1, 6.3)	4.5 (3.8, 5.4)	6.3 (5, 7.8)	4.6 (3.6, 5.7)	4.7 (4.1, 5.5)	6.3 (5.5, 7.3)	.23	1.2 (0.95, 1.6)	1.3 (−0.2, 2.7)
Inositol	4.9 (4, 6)	5.2 (4.2, 6.4)	4.7 (3.9, 5.5)	6.3 (5.1, 7.7)	5.1 (4, 6.4)	4.6 (4, 5.2)	6.5 (5.5, 7.6)	.16	1.3 (1.0, 1.7)	1.5 (0.1, 3.0)
Iron, Excluding MVMM*	2.9 (2.6, 3.2)	3.1 (2.5, 3.9)	3.1 (2.5, 3.8)	3.2 (2.4, 4.3)	3.8 (3, 4.8)	2.9 (2.4, 3.5)	3 (2.5, 3.7)	.65	1.1 (0.85, 1.3)	0.2 (−0.5, 0.8)
Lycopene Excluding MVMM (men only)*	-	-	0.8 (0.4, 1.5)	0.7 (0.3, 1.3)	0.6 (0.4, 1.1)	0.5 (0.2, 0.9)	0.7 (0.3, 1.4)	.24	5.6 (1.3, 24)	0.5 (0.1, 1.1)

	30-day prevalence of use % (95% confidence interval [CI])[d]								2011–2012 vs 1999–2000	
	1999–2000 (n=4,863)	2001–2002 (n=5,396)	2003–2004 (n=5,028)	2005–2006 (n=4,972)	2007–2008 (n=5,930)	2009–2010 (n=6,213)	2011–2012 (n=5,556)	p-trend	Ratio	Difference
Vitamin A, Excluding MVMM*	3.1 (2.7, 3.5)	4.1 (3.3, 5.1)	3.2 (2.6, 3.9)	3.4 (2.7, 4.2)	3 (2.4, 3.7)	2.8 (2.1, 3.7)	3.5 (2.8, 4.4)	.43	1.1 (0.88, 1.5)	0.4 (−0.4, 1.3)
Vitamin D*	37 (34, 39)	38 (36, 40)	39 (36, 42)	41 (39, 43)	36 (33, 39)	39 (37, 41)	40 (38, 43)	.14	1.1 (1.0, 1.2)	3.9 (0.5, 7.4)
Vitamin K	24 (22, 26)	24 (23, 26)	27 (24, 29)	28 (26, 30)	25 (22, 27)	25 (24, 27)	23 (22, 25)	.53	0.97 (0.86, 1.1)	−0.8 (−3.6, 2.0)

ABBREVIATIONS: MVMM (Multivitamin/multimineral)

*
Indicates that the trend markedly varied for overall use and use excluding MVMM, and therefore both trends are presented. Detailed information on each trend, both overall and exclusive of MVMM is presented in eTable 2.

[a]
Among adults ages 20 years.

[b]
Results are presented for any use of each individual supplement, regardless of whether taken as an individual supplement or as a combination supplement, such as a MVMM. Results are also presented exclusive of MVMM if the two trends markedly varied. In these cases, both results (inclusive and exclusive of MVMM) are marked by a star so as to indicate that results are presented both ways.

[c]
A 'decrease' corresponds to a ratio<1 and p-trend<0.05, an 'increase' represents a ratio>1 and p-trend<0.05, and 'stable' represents a p-trend 0.05.

[d]
Data are weighted to be nationally representative. If the relative standard error exceeds 30%, data are suppressed (as indicated by a dash), consistent with NHANES reporting guidelines.[20]

[e]
Defined as supplement products containing ten or more vitamins and/or minerals. This is the primary definition used in this paper, and is the variable used when defining use exclusive of MVMM elsewhere in the paper and tables.

[f]
Defined as supplements containing three or more vitamins and 1 or more minerals

Table 3

Trends in Use of Non-vitamin, Non-mineral Specialty Supplements among US Adults[a]: 1999–2000 through 2011–2012[*,b]

	30-day prevalence of use % (95% confidence interval [CI])[c]								Prevalence in 2011–12 vs. 1999–2000	
	1999–2000 (n=4,863)	2001–2002 (n=5,396)	2003–2004 (n=5,028)	2005–2006 (n=4,972)	2007–2008 (n=5,930)	2009–2010 (n=6,213)	2011–2012 (n=5,556)	p-trend	Ratio	Difference
INCREASED										
Co-enzyme Q10	1.1 (0.8, 1.7)	1.5 (1.0, 2.1)	2.5 (2.0, 3.1)	3.9 (3.3, 4.6)	2.8 (2.2, 3.7)	2.6 (2.1, 3.2)	2.8 (2.1, 3.7)	<.001	2.4 (1.5, 3.9)	1.6 (0.7, 2.5)
Cranberry	-	1.2 (0.8, 1.9)	1.3 (1.0, 1.7)	1.9 (1.4, 2.6)	1.7 (1.2, 2.3)	1.5 (1.1, 1.9)	2.4 (1.8, 3.1)	<.001	6.1 (3.0, 12.3)	2.0 (1.3, 2.7)
Green tea/EGCG	0.8 (0.5, 1.2)	1.6 (1.2, 2.1)	2.8 (2.1, 3.7)	5.5 (4.3, 6.9)	3.3 (2.7, 4.0)	3.2 (2.5, 4.1)	2.9 (2.0, 4.2)	<.001	3.7 (2.1, 6.4)	2.1 (1.0, 3.3)
Methylsulfonylmethane (MSM)	0.5 (0.3, 0.9)	1.0 (0.8, 1.4)	1.9 (1.2, 3.0)	1.9 (1.5, 2.4)	2.4 (1.8, 3.1)	1.8 (1.5, 2.3)	1.9 (1.5, 2.4)	<.001	3.6 (2.0, 6.4)	1.4 (0.8, 1.9)
Omega-3 fatty acids of any type	1.9 (1.4, 2.6)	2.8 (2.0, 3.8)	4.1 (3.1, 5.3)	7.1 (5.6, 9.0)	11 (8.9, 13)	11 (10, 13)	13 (11, 15)	<.001	6.8 (4.9, 9.3)	11 (9.4, 13)
Fish oil/EPA/DHA/DPA	1.3 (0.9, 1.9)	1.7 (1.1, 2.5)	3.0 (2.3, 3.9)	5.5 (4.0, 7.6)	9.2 (7.5, 11)	10 (9.1, 12)	12 (11, 14)	<.001	9.1 (6.2, 13.5)	11 (9.1, 12)
Alpha-linolenic acid/flaxseed	-	1.0 (0.8, 1.4)	1.4 (0.9, 2.2)	2.1 (1.6, 2.7)	2.8 (2.1, 3.7)	1.8 (1.4, 2.3)	2.1 (1.5, 2.8)	<.001	2.6 (1.3, 5.0)	1.3 (0.5, 2.0)
Omega-6 fatty acids	0.7 (0.4, 1.2)	0.9 (0.6, 1.3)	1.4 (0.8, 2.4)	2.4 (1.9, 3.1)	2.4 (1.8, 3.0)	1.5 (1.1, 2.1)	2.2 (1.6, 2.9)	<.001	3.1 (1.6, 6.0)	1.5 (0.8, 2.2)
Omega-9 fatty acids	0.6 (0.3, 1.0)	0.7 (0.4, 1.1)	1.1 (0.6, 1.9)	1.7 (1.2, 2.4)	2.1 (1.5, 2.8)	1.2 (0.9, 1.6)	1.8 (1.3, 2.5)	<.001	3.2 (1.7, 6.0)	1.2 (0.5, 1.9)
Probiotic	-	1.0 (0.6, 1.4)	0.9 (0.6, 1.4)	1.8 (1.5, 2.2)	0.8 (0.6, 1.2)	1.3 (1.1, 1.6)	2.2 (1.6, 2.9)	.003	2.4 (1.2, 4.9)	1.3 (0.4, 2.1)
DECREASED										
Echinacea	1.9 (1.4, 2.5)	1.3 (1.0, 1.8)	1.3 (0.9, 2.0)	1.5 (1.1, 2.0)	1 (0.8, 1.3)	0.6 (0.4, 1.0)	0.7 (0.5, 1.1)	<.001	0.38 (0.22, 0.65)	−1.2 (−1.8, −0.6)
Garlic	4.6 (4.1, 5.3)	3.6 (2.9, 4.5)	2.6 (2.0, 3.5)	2.9 (2.3, 3.7)	2.1 (1.5, 3.0)	1.7 (1.4, 2.2)	1.5 (1.1, 1.9)	<.001	0.31 (0.24, 0.41)	−3.2 (−3.9, −2.5)
Gingko biloba	4.6 (3.7, 5.7)	5.0 (4.0, 6.3)	2.9 (2.3, 3.7)	3.7 (3.1, 4.4)	2.5 (1.8, 3.5)	2.4 (1.9, 3.0)	2.0 (1.4, 2.7)	<.001	0.43 (0.28, 0.64)	−2.6 (−3.8, −1.5)
Ginseng	6.0 (4.8, 7.4)	7.0 (5.9, 8.4)	4.1 (3.4, 5.0)	4.2 (3.5, 4.9)	2.4 (1.6, 3.5)	1.9 (1.4, 2.6)	1.6 (1.1, 2.2)	<.001	0.26 (0.18, 0.39)	−4.4 (−5.8, −3.0)
Para-aminobenzoic acid (PABA)	4.5 (3.5, 5.7)	4.1 (3.4, 4.9)	3.1 (2.4, 3.9)	3.4 (2.5, 4.7)	1.9 (1.4, 2.7)	1.3 (1.1, 1.6)	2.2 (1.6, 3.0)	<.001	0.49 (0.33, 0.72)	−2.3 (−3.5, −1.0)
STABLE										
Amino acids	4.5 (3.4, 5.9)	4.7 (4.1, 5.4)	4.3 (3.5, 5.2)	5.0 (4.2, 5.9)	3.8 (2.9, 4.8)	3.4 (2.9, 3.9)	4.3 (3.6, 5.1)	.11	0.96 (0.69, 1.3)	−0.2 (−1.6, 1.2)
Bilberry	0.6 (0.4, 1.2)	1.6 (1.0, 2.5)	1.6 (1.1, 2.4)	3.0 (2.5, 3.7)	1.7 (1.3, 2.2)	1.1 (0.8, 1.6)	1.4 (0.9, 2.2)	.47	2.1 (1.0, 4.5)	0.7 (0.0, 1.5)
Bromelain	0.8 (0.5, 1.3)	1.4 (1.0, 2.0)	0.8 (0.6, 1.3)	1.6 (1.3, 2.1)	1.2 (0.8, 1.8)	1.1 (0.8, 1.5)	1.0 (0.6, 1.6)	.88	1.2 (0.62, 2.3)	0.2 (−0.4, 0.8)
Chondroitin	1.8 (1.3, 2.6)	2.4 (2.0, 2.9)	3.1 (2.0, 4.7)	3.6 (2.9, 4.6)	3.3 (2.6, 4.3)	2.8 (2.4, 3.3)	2.2 (1.7, 2.9)	.30	1.2 (0.77, 1.9)	0.4 (−0.5, 1.3)
Fiber	2.3 (1.7, 3.0)	2.5 (2.2, 2.9)	2.5 (1.9, 3.2)	3.5 (2.6, 4.7)	3.3 (2.6, 4.4)	2.0 (1.6, 2.6)	2.4 (1.6, 3.5)	.95	1.0 (0.63, 1.7)	0.1 (−1.1, 1.2)
Ginger	1.7 (1.2, 2.4)	2.0 (1.5, 2.7)	1.4 (1.0, 1.9)	2.1 (1.6, 2.9)	1.5 (1.1, 2.0)	1.4 (1.0, 2.1)	1.5 (1.1, 2.0)	.24	0.89 (0.55, 1.4)	−0.2 (−0.9, 0.6)

	30-day prevalence of use % (95% confidence interval [CI])[c]								Prevalence in 2011–12 vs. 1999–2000	
	1999–2000 (n=4,863)	2001–2002 (n=5,396)	2003–2004 (n=5,028)	2005–2006 (n=4,972)	2007–2008 (n=5,930)	2009–2010 (n=6,213)	2011–2012 (n=5,556)	p-trend	Ratio	Difference
Glucosamine	2.9 (2.3, 3.8)	3.5 (2.9, 4.2)	4.9 (3.5, 6.7)	5.2 (4.2, 6.5)	4.6 (3.7, 5.8)	3.9 (3.3, 4.7)	3.5 (2.9, 4.2)	.37	1.2 (0.87, 1.6)	0.6 (−0.4, 1.5)
Grape seed	1.8 (1.1, 2.9)	2.7 (1.8, 4.1)	1.8 (1.4, 2.4)	2.2 (1.8, 2.7)	1.3 (1.0, 1.8)	2.2 (1.7, 2.8)	1.7 (1.0, 2.8)	.42	0.97 (0.47, 2.0)	−0.1 (−1.3, 1.2)
Quercetin	0.8 (0.6, 1.1)	1.3 (0.9, 1.8)	1.3 (0.8, 2.0)	1.5 (1.2, 1.9)	0.9 (0.7, 1.2)	1.1 (0.8, 1.4)	1.0 (0.6, 1.7)	.79	1.2 (0.66, 2.3)	0.2 (−0.4, 0.8)
Saw palmetto (men only)	2.5 (1.8, 3.6)	3.2 (2.6, 4.1)	4.2 (2.9, 5.9)	4.3 (3.4, 5.5)	2.3 (1.6, 3.2)	2.2 (1.7, 2.9)	2.7 (2.2, 3.4)	.075	1.1 (0.71, 1.6)	0.2 (−0.9, 1.2)
Soy	-	1.7 (1.2, 2.4)	1.9 (1.6, 2.4)	2.0 (1.3, 3.0)	1.9 (1.4, 2.7)	1.4 (1.0, 1.9)	1.7 (1.3, 2.2)	.84	1.3 (0.66, 2.5)	0.4 (−0.5, 1.3)

ABBREVIATIONS: DHA (docosahexaenoic acid); DPA (docosapentaenoic acid); EGCG (epigallocatechin gallate); EPA (eicosapentaenoic acid); MVMM (Multivitamin/multimineral)

*
Detailed information on each trend, both overall and exclusive of MVMM is presented in eTable 3

[a] Among adults ages ≥ 20 years.

[b] A 'decrease' corresponds to a ratio<1 and p-trend<0.05, an 'increase' represents a ratio>1 and p-trend<0.05, and 'stable' represents a p-trend ≥ 0.05.

[c] Data are weighted to be nationally representative.

- Dash represents suppressed data due to unstable data, if the relative standard error exceeds 30%, consistent with NHANES reporting guidelines.[40]