British Journal of Nutrition (2023), 129, 2174–2181 doi:10.1017/S000711452200321X

Dietary supplement use in Greece: methodology and findings from the National Health and Nutrition Survey – HYDRIA (2013–2014)

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(Submitted 11 April 2022 – Final revision received 17 September 2022 – Accepted 28 September 2022 – First published online 10 October 2022)

Abstract

The use of dietary supplements (DS) is increasing worldwide. There is limited evidence of their intake level and mode of consumption in association with the Greek population's dietary and lifestyle habits. Adults (*n* 4011, 1873 males and 2138 females) aged > 18 years old living in Greece were included in the 2013–2014 National Health and Nutrition Survey – HYDRIA. A dietary supplement user (DSU) was defined as anyone who reported one or more DS on either a Food Propensity Questionnaire, two 24-h dietary recalls, or a questionnaire completed during the blood sample collection examination. DS use was examined according to socio-economic, anthropometric and lifestyle characteristics and the participants' health and dietary status. DS use was reported by 31 % of the population (40 % women and 22 % men), and it was higher among individuals living in urban areas, men with good self-reported health status and women with a chronic medical condition and higher consumption of fruits. The types of DS more frequently reported were multivitamins with minerals (5·4 %), Ca (5·3 %), multivitamins (4·7 %) and Fe (4·6 %). MVM supplements were preferred by men, while Ca was more frequently reported by women and participants with low education levels. Plant- and oil-based supplement use was below 5 %. Whether DS intake benefits health must be explored. It should also be assessed if dietary supplement intake is as efficient as food intake.

Key words: **Dietary supplement: Food supplement: Greece: National Nutrition Survey: Methodology**

Dietary supplements (DS) are defined as 'Foodstuffs the purpose of which is to supplement the normal diet and which are concentrated sources of nutrients or other substances with a nutritional or physiological effect, alone or in combination, marketed in dose form[(1)]'.

The expanding DS market[(2)] offers a wide variety of DS products to people. However, the opinions of scientists are contradictory regarding efficacy or safety and whether DS contribute to achieving the recommended nutrient amounts for the general population[(3,4)]. Therefore, recognising the profile of a dietary supplement user (DSU) and the DS consumption (frequency and amount) may provide information on the nutrient intake, on top of the eating patterns, and – in the long run – eventually, reveal possible associations with chronic conditions. Based on such detailed findings, conveying more precise guidelines on DS use may be needed.

Studies in European countries have shown that the percentage of DSU increased over time and revealed several socio-demographic, health and lifestyle differences among the DSU. National dietary guidelines in Greece indicated that 'healthy adults, except for pregnant women, do not need dietary supplements when they follow a balanced diet[(5)].' Detailed information on DS use in Greece is lacking in a representative country-wide sample. The present study, with the Project Title: 'HYDRIA. Programme and targeted action on the diet and health of the Greek population: development and implementation of methodology and documentation' describes DS use in a nationally representative sample in Greece, following the population's socio-demographic, lifestyle, health and dietary characteristics. Results from the HYDRIA survey could serve as a baseline for future studies regarding DS use in Greece.

Abbreviations: DSU, dietary supplement user; DS, dietary supplements; FPQ, Food Propensity Questionnaire.

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Methods

The HYDRIA survey was a cross-sectional study that assessed the diet and health status of the adult population in Greece[6] and was coordinated by the Hellenic Health Foundation in collaboration with the Hellenic Centre for Disease Control & Prevention of the Hellenic Ministry of Health. The survey was based on the standards of the European Health Examination Survey – EHES[7] and conducted according to the guidelines laid down in the Declaration of Helsinki. All procedures involving human subjects/patients were approved by the Hellenic Data Protection Authority (www.dpa.gr) to establish and operate a file registry of sensitive personal data under law N.2472/1997. The HYDRIA survey data are protected under applicable national law. All the collected data are inputted and stored electronically on the Hellenic Health Foundation central server anonymously and securely to protect participants' privacy. Written informed consent was obtained from all subjects/patients.

The study included a representative sample of 4011 men and women > 18 years old, permanent residents from the fifty-one prefectures of the thirteen regions of Greece[6]. A two-stage stratified (by area, sex and age group) random sampling scheme was applied to select the sample based on the last population census of 2011. The field data collection was operated from June 2013 to December 2014, and the appointments were held in Health Centres or local facilities close to participants' residences after personal telephone contact. Data collection included standard interviewing questionnaires through a personal interview (computer-assisted personnel) to obtain information on demographic characteristics, diet (assessed by two 24-h dietary recalls and a non-quantitative Food Propensity Questionnaire-FPQ), health (chronic diseases, medication and dietary supplements) and lifestyle habits (smoking and exercise). In addition, anthropometric characteristics (e.g. body weight, height and waist circumference) and blood pressure were measured. Blood samples were drawn in compliance with standardised procedures by trained health professionals during the interviews. Details for the HYDRIA survey's design, methodology and data collection have been described elsewhere[6].

DS use was recorded using three different methods: two 24-h dietary recalls, the FPQ and a questionnaire completed during the participants' blood sample collection examination. All dietary assessment methods were conducted by interviewer-administered questionnaires.

Participants joined in two non-consecutive 24-h dietary recall interviews conducted by a trained interviewer (the first 24-h dietary recall was completed face to face on the first day of examination, while the second by telephone about 30 d later). The interview days were randomly assigned between week and weekend days (one day during the week and one day during the weekend). To avoid collecting data either on two weekdays or two weekend days, it was planned for the 'Monday to Thursday' participants to repeat the 24-h dietary recall Fridays to Sundays, only.

During the two 24-h dietary recall interviews, each participant was asked whether they consumed any DS the day before the interview. The question was open-ended, and the participant could report the type or the brand name of any DS used. Participants were also asked to report the dose and the hour of consumption of each DS used. There was no restriction on the number of DS that the subjects could report during the recall interviews. For the 24-h dietary recalls, a DSU was defined as anyone who reported using one or more DS in at least one of the two 24-h dietary recalled days.

Participants also provided information on their dietary consumption by answering a non-quantitative FPQ which assessed the frequency of consumption of a pre-defined list of fourteen DS during the last 12 months. The participants were asked to report if they used any of the following DS: vitamin C, vitamin D, folic acid, multivitamin supplements containing only vitamins, multivitamin supplements containing both vitamins and minerals, Ca, Fe, Mg, oil-based supplements, herbs or other plant-based supplements, probiotics or prebiotics, algae supplements, supplements for muscle building and supplements for weight control. At the end of the questionnaire, participants could also report any DS that was not included in the previous groups. For the FPQ, a DSU was defined as anyone who reported frequent use of any supplement at least one day per month.

Finally, information was collected on DS use during the blood sample collection examination. Participants were asked to report and bring all medications and DS they used in the last 24 h, the last week and regularly to the examination site. The product's brand name and the number of units and times taken were recorded for each of the three time periods, respectively. All medications were categorised based on the Anatomical Therapeutic Classification system, recommended by WHO and adopted by the Greek National Organisation for Medicines. For this study, it was decided to consider the following Anatomical Therapeutic Classification system-code medications as supplements: vitamin C (A11GA01); a combination of vitamin A and vitamin E (A11JA); vitamin D (A11CC); vitamin B (A11DB); folic acid (B03BB01); Ca (A12A); Fe (B03A); *n*-3-fatty acids (C10AX06); probiotics incl. saccharomyces boulardii (A07FA02); L-carnitine (A16AA01); valeriana radix (N05CM09) and vitamin E (A11HA03). DSU were defined as the participants who reported any supplement, including the Anatomical Therapeutic Classification system-code medications described above for this questionnaire. Other medications containing nutrients different from those stated above, such as homeopathic medicines and foods, were not considered DS. DSU were grouped into fifteen categories, following the above-mentioned classification of FPQ.

Overall, a DSU was considered as anyone who reported taking one or more supplements in at least one of the three following assessment methods: two 24-h dietary recalls, FPQ and the questionnaire administered during the blood sample collection examination.

During the 24-h dietary recall interviews, the participants recalled all foods and beverages consumed the previous day, whereas for the FPQ, they reported the usual frequency of consumption of a pre-specified list of eighty-eight foods and beverages.

Participants also provided information on their socio-economic, anthropometric, health status and lifestyle characteristics during the face-to-face interviews. For these present analyses, socio-economic variables were categorised as follows: age

(18–34, 35–44, 45–54, 55–64, 65–74 and ≥ 75 years)/education level: low (none or up to 9 years of education), intermediate (more than 9 and up to 12 years of education), high (more than 12 years of education, including holding a bachelor or higher degree) based on the International Standard Classification of Education/occupation status: employed (including unpaid family helpers and persons on sick, holiday or parental leave), unemployed, students (including unpaid interns), pensioners and those occupied with homemaking/marital status: single, married, widowed, separated, divorced/residential area: urban, semi-urban, rural and geographical area: Attica, Northern Greece (including Epirus, Macedonia and Thrace), Central Greece (including Peloponnese, Western Greece, Thessaly and the Ionian Islands), the Aegean Islands and Crete.

Information on anthropometric characteristics was collected using calibrated equipment and under the standardised protocols of the EHES Reference Centre[7]. In this study, the following variables were used: Body Mass Index (BMI) based on measurements of weight and height: BMI< 18·5 underweight, BMI 18·5–24·9 normal weight, BMI 25–29·9 overweight, BMI≥ 30 kg/m^2 obese[8]/waist:hip Ratio (WHR): no risk, increased risk (men with WHR ≥ 90 and women with WHR ≥ 85)[9]/waist circumference (WC): no risk, increased risk (WC > 94–102 cm in men and WC > 80–88 cm in women), high risk (WC > 102 cm in men and WC > 88 cm in women)[9]/physical activity based on Metabolic Equivalent of Task (MET) recommendations: 1·0–1·5 metabolic equivalent of tasks as sedentary behaviour, 1·6–2·9 metabolic equivalent of tasks as light intensity activity (3·0–5·9 metabolic equivalent of tasks as moderate-intensity physical activity) [10].

Lifestyle and health variables included smoking status (current smoker, former smoker and never smoked)/self-reported health status (very good-good, moderate and poor-very poor)/self-reported chronic morbidity at the time of the interview (yes, no)/self-reported chronic disease, i.e. a condition lasting at least 6 months (yes, no). In addition, usual fruit, vegetable, and alcohol intakes were categorised using the median consumption of individuals in two groups (below or above median intake).

Statistical methods

The HYDRIA survey used a complex sample design to estimate nationally representative results regarding the diet and health of the adult population in Greece, and for this reason, the weighting factors were applied for nationally representative estimates.

Percentages of use of DS in men and women were calculated separately and compared among the different socio-economic, lifestyle and health variable groups using χ^2 tests. The median values for the usual intakes of vegetables, fruit and alcohol were calculated using the National Cancer Institute method, which uses a two-part model for modelling single dietary components consumed episodically[11]. The vegetables, fruit and alcohol models were stratified by sex and adjusted by the corresponding FPQ frequency food variables, age groups, education level and geographical region. The analysis for the National Cancer Institute method was conducted using SAS 9·3 (SAS Institute Inc.). Statistical significance was considered at $P < 0·05$.

Results

From the 8000 individuals (aged 18+ years), the response rate was 50 %, meaning that the representative sample counted 4011 individuals (1873 males and 2138 females). Regarding the age and gender distribution, this was 47 % and 53 % in the HYDRIA-survey *v.* 48 % and 52 % in the Greek population (based on the Greek Census of 2011), respectively.

The percentage of participants who reported DS use in all three dietary assessment methods was 8·3 %. About 69 % of adults did not report a DS in any of the three dietary assessment methods. The percentage of participants who reported DS using only one or two dietary assessment methods ranged between 1·4 % (during 24-h dietary recalls and blood examination) and 8·2 % (only during the FPQ interview) (online Supplementary Table 3S). Overall, supplement use was reported by one-third (31·2 %) of the adult population in Greece (Table 1).

The consumption of DS by women was higher and almost double (39·9 %) that of men (21·8 %) ($P < 0·001$). The prevalence of DS use in the two 24-h dietary recalls, FPQ and the questionnaire used during the blood examination was 14·3 %, 22·8 % and 18·6 %, respectively.

The participants' demographic, lifestyle and health status characteristics are shown in Table 2.

DS use was significantly higher among employed men with an intermediate level of education, BMI between 25 and 29·9 kg/m^2 and waist:hip ratio and waist circumference predisposed to increased risk and high risk, respectively, for cardiometabolic disease. Men who self-reported their health status as 'very good' or 'good' presented a high percentage of DS use, while DS use was higher in women with a chronic disease. Women with a consumption > 109 g/d of fruits showed higher use of DS (51 %) than those with a lower consumption (31 %) and the non-consumers (18 %). Both men and women who lived in an urban area and were residents of Attica showed higher percentages of DS use.

The most commonly used supplements varied by age group, both in men and women (data presented in online Supplementary Tables 1S and 2S).

Men in the 18–34 year age group consumed a higher proportion of multivitamins with minerals (47 %), supplements for muscle building (59 %) and other or non-specified supplements (34 %). Fe supplements were most frequently used by the 65–74 year age group among men, while the percentage of men who used oil-based supplements (fatty acids) was higher in the 55–64 year age group. Women consumed a higher percentage of vitamin C (41 %) and supplements for weight loss (30 %) in 18–34 years. Women in the 55–64 year age group most frequently reported vitamin D and oil-based supplements. Ca-based supplements showed an increasing gradient from younger to older and were most commonly used by women aged 55–74 years (26 %). In general, women of reproductive age consumed less vitamin D and Ca supplements than older women. The percentage for Fe consumption showed a decreasing gradient from younger to older and was the highest in women up to 34 years old (32·6 %). DS with algae were most frequently reported among women aged 45–54 years old (29 %).

Table 1. Dietary supplement use (%), by supplement assessment method in the National Health and Nutrition Survey – HYDRIA (*n* 4011, 1873 males and 2138 females)

	Total		Men		Women	
Supplement assessment method	Non-users (%)	Users (%)	Non-users (%)	Users (%)	Non-users (%)	Users (%)
24-h dietary recalls	85·7	14·3	90·5	9·5	81·4	18·6
FPQ	77·2	22·8	82·3	17·7	72·4	27·6
Questionnaire during blood sample collection examination	81·4	18·6	89·2	10·8	74·1	25·9
Total	68·8	31·2	78·2	21·8	60·1	39·9

FPQ, Food Propensity Questionnaire.

As shown in Fig. 1, multivitamins with minerals (5·4 %), Ca (5·3 %), multivitamins (4·7 %) and Fe (4·6 %) were the most frequent DS types used by the adult population in Greece.

Discussion

Based on the National Health and Nutrition Survey – HYDRIA, one-third of the Greek population are DSUs who live in urban areas and more are females (40 %). The study showed that gender, level of urbanity and education, employment, health condition and anthropometrics, although associated with the use of DS are not determining factors for all categories of DS use.

Multivitamins with minerals (used mainly by men), Ca and Fe (used mainly by women) were among the DS being reported more frequently. Vitamin C seems not to have a replacement effect, i.e. to substitute fruits with DS, since – in this study – women with high fruit intakes were the highest DSU. This fact could indicate that women mainly look to treat a health condition via a healthy diet, with the addition of DS consumption. Of note that according to EU and international legislation, the use of the terms 'treatment', 'cure' and 'prevention' is not permitted for food products, including food supplements. Reference to such property makes the product fall legally in the area of drugs[12].

The percentage regarding Fe consumption was the highest in women up to 34 years old (32·6 %); thus, raising the question as to whether women in reproductive age are meeting Iron recommendations through food only. Menopausal women (45–64 years in the HYDRIA sample) reported use of vitamin D and Ca-containing DS more often. Dietary Ca might be more efficient than supplementary form, and the data in the literature regarding the use of vitamin D and Ca supplements for the prevention of osteoporosis are conflicting[13]. The latter age group also used oil-based supplements, most likely to enhance the *n*-3-fatty acids intake. Randomised trial evidence does not support fish oil supplements to reduce the risk of non-communicable diseases such as CVD or type 2 diabetes[4]. Based on the findings mentioned earlier, further investigation of the intake for Fe- and Ca food sources and weekly fish consumption is needed to observe whether the related DS use provides a good balance between safety and efficacy.

Dietary supplement use in Greece over the past 20 years

In the HYDRIA survey, 22 % of men and 40 % of women in the overall population were DSU. Similar results were found in a recent study[14].

The EPIC-Greek cohort[15], conducted approximately 20 years earlier, recorded 2 % Greek male DSU and 6·7 % female DSU, with diverse DS preferences by gender, as shown in Fig. 2. If multiple different categories of dietary supplements were taken by the same person, these were counted separately.

It seems that DS intake is a rapidly growing market in Greece[2]. Greece was ranked 22nd (out of thirty-five countries) in Europe, with a DS market valued at over 30 million Euro in 2015, which rose to more than 43 million Euro in 2020[2].

Over the years, the growing DS market offers much more differentiated products for greater customisation of needs for different population segments[16]. Based on research findings, related approved European Food Safety Authority health claims, and marketing strategies, the DS market seeks to meet consumers' personalised dietary needs.

Dietary supplement use in Greece compared with other countries

To identify several National Health and Nutrition Studies, literature research was conducted in the European Regions[17], the European Food Safety Authority[18] and the Global Dietary Database – GDD[19]. Studies included were limited to those conducted at approximately the same time period (between 2010 and 2020) as the HYDRIA survey.

It was observed that there is no global consensus on defining the various DS, dietary supplements, natural health products or complementary medicines among the different countries. It is not easy to compare the results of the various studies conducted, considering the different methodologies used.

The highest DS use was found in the UK (48 %)[20], followed by Finland (43 %)[21], the Netherlands (42 %)[22], Ireland (28 %)[23], Portugal (26·6 %)[24] and Sweden (21 %)[25]. In the USA[26], the DSU exceeded half of the population (52 %), followed by 45·6 % in Canada[27] and 43·2 % in Australia[28]. China[29] showed a particularly low DS consumption 0·71 %. In all countries, women were predominantly higher DSU in comparison with men.

Trends and concerns on dietary supplement consumption

Studies indicate that vitamins and minerals were once used to treat nutrient deficiencies, and nowadays, DS is used preventatively against chronic health conditions[30,31]. The rising figures are causing suspicion and controversies in the scientific community, whether the DS intake has health benefits[4]. Some studies have concluded positive health effects from DS use[3]. In addition, evidence shows that the current intake of vitamins from

Table 2. Demographic, lifestyle and health status characteristics of adults in the National Health and Nutrition Survey – HYDRIA (*n* 4011, 1873 males and 2138 females)

	Men			Women			Total		
Characteristic	Non-users	Users	*P* value*	Non-users	Users	*P* value*	Non-users	Users	*P* value*
Age, years									
18–34	24·0	30·7	0·142	25·6	19·7	0·251	24·7	23·4	0·841
35–44	18·7	20·8		17·0	18·6		17·9	19·3	
45–54	18·2	15·3		17·0	17·6		17·7	16·8	
55–64	14·8	14·8		15·3	14·6		15·0	14·7	
65–74	12·3	10·3		11·3	14·5		11·8	13·1	
≥ 75	12·1	8·2		13·9	14·9		12·9	12·6	
Education†									
Low	38·4	20·8	< 0·001	44·4	42·6	0·606	41·1	35·2	0·003
Intermediate	40·4	47·0		36·4	36·1		38·6	39·8	
High	21·2	32·2		19·3	21·3		20·3	25·0	
Occupation‡									
Employed	50·0	58·5	0·045	33·2	29·7	0·098	42·4	39·4	< 0·001
Unemployed	14·9	13·1		15·9	12·7		15·4	12·8	
Student	5·0	7·1		5·2	4·6		5·1	5·4	
Pensioner	30·0	21·3		20·1	25·1		25·5	23·8	
House-keeping	0·06	0·0		25·6	27·9		11·6	18·5	
Marital status									
Single	28·0	37·8	< 0·001	21·3	17·3	0·296	25·0	24·2	0·029
Married	64·8	54·0		60·3	60·9		62·8	58·5	
Widowed	4·1	2·1		14·4	16·4		8·7	11·5	
Divorced/Separated	3·2	6·2		0·4	5·4		3·5	5·7	
Residential area									
Urban	55·7	71·0	0·004	57·6	68·0	0·005	56·6	69·0	< 0·001
Semi-urban	16·5	11·3		16·1	9·6		16·3	10·2	
Rural area	27·7	17·7		26·3	22·4		27·1	20·8	
Region§									
Attica	33·3	44·3	0·013	32·9	42·6	0·007	33·1	43·1	< 0·001
Northern Greece	29·5	25·2		30·7	25·4		30·0	25·3	
Central Greece	27·1	19·0		25·5	23·0		26·4	21·6	
Aegean Islands, Crete	10·1	11·6		10·9	9·0		10·4	9·9	
BMI‖, kg/m^2									
< 18·5	0·06	0·7	0·001	1·5	1·4	0·414	0·7	1·2	0·004
18·5–24·9	20·5	28·5		29·9	32·8		24·8	31·3	
25–29·9	43·7	42·8		31·1	32·9		37·9	36·2	
≥ 30	35·8	27·9		37·5	32·9		36·6	31·3	
WHR¶									
No risk	26·4	37·4	0·001	51·1	52·0	0·768	37·6	47·1	< 0·001
Increased risk	73·6	62·6		48·9	48·0		62·4	52·9	
WC** cm									
No risk	32·3	45·1	< 0·001	28·0	27·8	0·296	30·3	33·6	0·247
Increased risk	24·7	22·8		16·5	19·6		21·0	20·7	
High risk	43·0	32·1		55·5	52·6		48·7	45·7	
Physical activity, MET††									
Sedentary behaviour	30·0	31·6	0·441	17·0	20·0	0·400	24·1	24·0	0·146
Light-intensity	66·0	65·9		81·6	79·0		73·1	74·6	
Moderate-intensity	4·0	2·5		1·4	0·9		2·8	1·4	
Smoking‡‡									
Smoker	38·9	41·4	0·428	33·8	30·0	0·117	36·6	33·9	0·042
Former smoker	31·3	27·0		11·3	14·9		22·2	19·0	
Never smoker	29·8	31·6		54·8	55·1		41·2	47·1	
Self-reported health status									
Very Good/Good	74·3	72·8	< 0·001	61·1	57·1	0·166	68·3	62·4	< 0·001
Moderate	23·3	20·0		32·4	32·9		27·5	28·5	
Poor/Very poor	2·4	7·2		6·5	10·0		4·2	9·1	
Chronic morbidity§§									
Yes	50·9	52·5	0·674	64·1	71·0	0·002	56·9	65·4	< 0·001
No	48·8	47·5		35·8	28·0		42·9	34·6	
Alcohol intake‖‖									
No drinkers	39·5	42·1	0·750	60·4	57·7	0·509	49·0	52·5	0·149
< Median	17·6	17·1		9·1	8·7		13·7	11·5	
≥ Median	42·9	40·8		30·5	33·6		37·3	36·0	
Fruit intake¶¶									
No consumers	30·8	22·8	0·060	24·0	17·9	0·041	27·7	19·5	< 0·001
< Median	23·0	24·1		29·5	31·0		25·9	28·6	
≥ Median	46·2	53·2		46·5	51·1		46·4	51·8	

Table 2. (*Continued*)

Characteristic	Men			Women			Total		
	Non-users	Users	*P* value*	Non-users	Users	*P* value*	Non-users	Users	*P* value*
Vegetables intake***									
No consumers	1·4	1·0	0·469	1·1	2·4	0·082	1·3	1·9	0·361
< Median	52·8	57·3		50·3	44·8		51·6	49·0	
≥ Median	45·8	41·7		48·5	52·8		47·1	49·0	

WHR, waist:hip ratio; WC, waist circumference; MET, metabolic equivalent of task.
* *P* values comparing supplement users to non-supplement users estimated by χ^2 test.
† Low: ≤ 9 years of education; intermediate: 10–12 years of education; high: > 12 years of education, including individuals with postgraduate and/or doctoral degrees.
‡ Employed category also includes unpaid employees in family businesses, paid apprentices, investors and persons on sick leave, holiday leave, maternity or parental leave; the student category includes unpaid interns.
§ Northern Greece: prefectures of Epirus, Eastern Macedonia and Thrace, Western and Central Macedonia; Central Greece: prefectures of Central Greece including West Greece and Peloponnese, Ionian Islands and Thessaly.
‖ BMI (kg/m^2) was calculated as weight (kg) divided by height squared (m^2) [8].
¶ Increased risk defined as waist: hip ratio WHR ≥ 0·90 in men and WHR ≥ 0·85 in women[9].
** Increased risk defined as waist circumference WC ≥ 94–101·9 cm in men and ≥ 80–87·9 cm in women; high risk defined as WC ≥ 102 cm in men and ≥ 88 cm in women[9].
†† 1·0–1·5 MET defined as sedentary behaviour, 1·6–2·9 MET defined as light intensity and 3–5·9 MET defined as moderate intensity[10].
‡‡ Smoker category includes current or occasional smokers.
§§ Participants reported if they were ill or had been ill the previous 12 months or longer with specific diseases and if diagnosed with the disease by a doctor (self-reported data). The percentages for the category 'don't know' were not included.
‖‖ Median for alcohol intake was estimated as 10 g/d in men and 2 g/d in women using the NCI method[11]. Non-drinkers are defined as those with zero consumption.
¶¶ Median for fruit intake was estimated as 91 g/d in men and 109 g/d in women using the NCI method[11]. Non-consumers are defined as those with zero consumption.
*** Median for vegetable intake was estimated as 203 g/d in men and 138 g/d in women using the NCI method[11]. Non-consumers are defined as those with zero consumption.

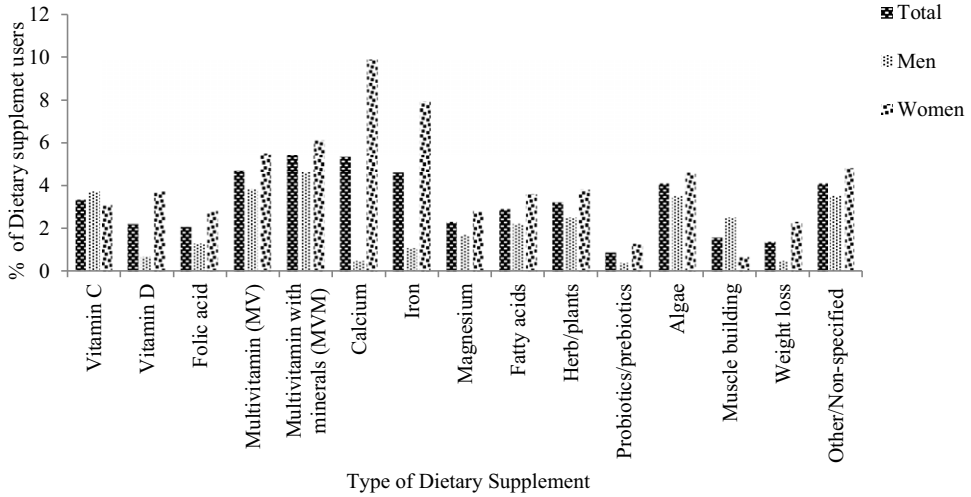

Fig. 1. Percentage (%) of dietary supplement users by type of dietary supplement and by gender in the National Health and Nutrition Survey – HYDRIA (*n* 4011, 1·873 males and 2·138 females).

foods in Europe is leading to a low risk of low intakes in all age and sex groups[32].

There is a concern regarding the quantities consumed and the regular use of DS in relation to the possibility of surpassing dietary guidelines on recommended nutrient intake levels. Studies suggested that DS should be used cautiously because adverse effects can occur, principally for intakes far higher than the recommended dietary allowances[33]. It is of note that there are no recommendations available for certain nutrients, including no defined tolerable upper intake levels[34], and the same issue applies to non-nutrient (e.g. herbal plants, botanicals and algae).

The HYDRIA survey results indicate that the associations between demographic, dietary and lifestyle characteristics suggest that the use of different DS categories differs according to products. Surveys about consumers' attitudes, norms and knowledge regarding DS within the context of actual dietary patterns and health risk profiles are necessary in order to shed light on critical demographic and dietary features.

DS use was not or was rarely considered in most National Nutrition Surveys. Although there is a rising market trend in DS consumption, surprisingly few existing national nutrition surveys in Europe record relevant DS data, as shown from the literature researched in this study[19]. Furthermore, existing approaches to evaluate usual intakes are not explicitly designed to handle DS, and little is known about the best methods to assess and report DS use[35]. Thus, it is a necessity to record the supplement intake as a separate food group regarding future

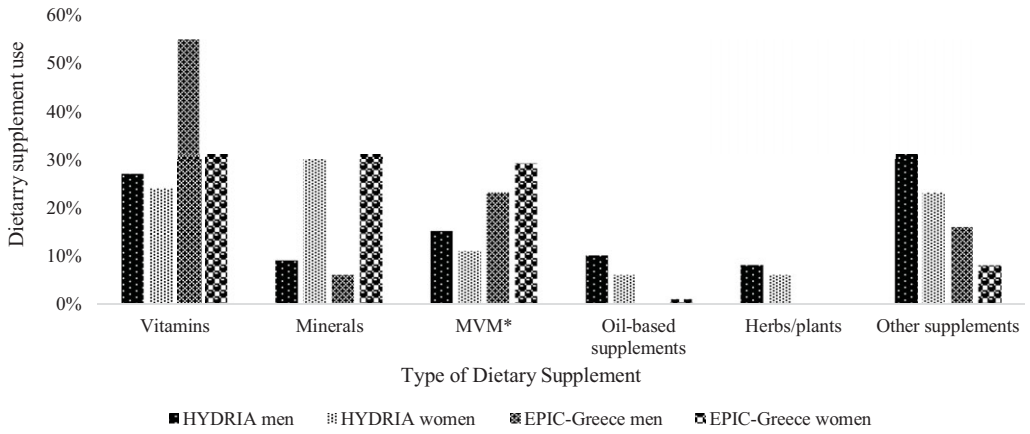

Fig. 2. Dietary supplement use (%) by gender and type of supplement in the National Health and Nutrition Survey – HYDRIA (2013–2014, *n* 4011, 1873 males and 2138 females) and EPIC (European Prospective Investigation into Cancer and Nutrition) study (1995–2000).

survey design. Additionally, common DS categories should be defined upon agreement among the involved scientific parties to allow for comparable data and comparisons between surveys.

Data on DS consumption are vital for national nutrition monitoring. They can contribute to characterising patterns of DS use in the population, estimating nutrient intake from supplements, evaluating total nutrient intake from food and DS and examining the diverse diet–health relations.

The self-reported method regarding some variables could be considered a limitation of the current approach, which was partially eliminated through the third data collection method, namely the questionnaire completed during the blood sample collection examination. A more general limitation is that many DS's 'multi' ingredient composition did not allow for retrieving figures for each nutrient separately.

In conclusion, the HYDRIA findings on DS use in Greece, presented in this study, could serve as a baseline for future research towards a better understanding of the efficacy and safety of these products. The upcoming relevant question could be whether the characteristics differ between people who take supplements very occasionally, to regular supplement users. Evaluating the food intake and its nutrient value will give an insight into whether DS compensates for malnutrition.

Acknowledgements

We wish to thank the members of the HYDRIA operational and fieldwork teams for their invaluable contribution to the study implementation. This study could not have been made possible without the hard work of so many people who constituted the HYDRIA team and more than 4,000 survey participants.

The National Health and Nutrition Survey – HYDRIA was co-financed by the European Social Fund of the European Union and national resources (Grand number: MIS 346 816).

T. A. formulating the research question, conceptualisation, funding acquisition, project administration and supervision. K. A., P. E. M., P. E. and T. A. designing the study and developing methodology. M. G., P. E. M. and P. E. data collection, investigation and software. M. G. and S. M. analysing data, data curation and formal analysis. K. A., P. E. M., P. E. and T. A interpreting the findings writing – original draft, and writing – review and editing, validation, visualisation and resources. All authors read and approved the manuscript.

The authors declare that there are no conflicts of interest.

Supplementary material

For supplementary material/s referred to in this article, please visit https://doi.org/10.1017/S000711452200321X

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British Journal of Nutrition