

A Critical Review of Diet Supplementation: The Rationale, Concerns and Guiding Principles in Modern Healthcare

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Abstract

There has been a massive surge in the intake of dietary supplements in recent years, with millions of people taking the “magic pills” worldwide, either with the hope of achieving general well-being, treat specific disease, or retard the aging process. Supplementing the diet with multivitamins and minerals (MVMs) has revolutionized modern healthcare, with many “experts” claiming such drugs have a critical role to play in the prevention and treatment of many health conditions. Many are of the opinion that since dietary supplements are mere extracts from certain foods and herbs, so unlike drugs, have no significant side effects, are “all natural,” and are therefore “safe” for a non-medical prescription. The association of the deficiency of some MVMs, such as vitamins C, D, and Zinc, with the increased incidence and progression of COVID-19, has also strengthened the argument in favor of routine diet supplementation. The objectives of this article are to investigate the health and therapeutic claims attributed to some dietary supplements, their safety concerns, and their possible role in modern healthcare. A review of related online free-full articles written in the English language published from 2000 to 2021 was done. While the pharmacokinetics and pharmacodynamics of some dietary supplements are clearly understood and established, others are still shrouded in serious confusions and safety concerns, especially for long-term use. Until more evidence is available, routine intake of dietary supplements should be discouraged, except there are clear medical indications. Rather, all people should ensure they get their required nutrients from whole foods.

Keywords: Chronic noncommunicable diseases, covid-19, dietary supplements, diet supplementation, micronutrients, multivitamins and minerals

INTRODUCTION

Dietary supplements can broadly be defined as any product (except tobacco) that contains one or more of either vitamins, minerals, phytochemicals, amino acids, herbs or other botanical compounds, and is intended to augment the nutritional value of a diet.^[1,2] It can also mean the metabolite, extract, concentrate, constituent, or combination of any dietary substance, like vitamins, minerals, phytochemicals, and amino acids which can improve the quality or quantity of a total dietary intake.^[1,2] Dietary supplements are marketed in the forms of either tablets, hard-shelled or soft-gels capsules, liquids, powders, or other forms are taken orally, as long as they are not obtainable as a conventional food or as a only component of a meal or diet.^[1-3]

The practice of supplementing the diet with multivitamins and minerals (MVMs) has been available for clinical use since the late 1800s and early 1900s.^[4-6] The original intention of adopting such practice into medical care is to prevent and treat

micronutrients deficiency as well for general well-being.^[4,5] However, over the years, more reasons for the use of dietary supplements have emerged, different combinations of MVMs are now available for different purposes, while advocacy for their use has been sustained through different massive marketing strategies.^[4,7] A practice that some healthcare professionals have even subscribed to and advocate the same to their patients. People now supplements their diet for diverse purposes—for general well-being and boosting of vitality; to replace the specific MVMs that they perceived to be deficient in their daily diet; to prevent or treat infectious diseases by boosting the immune system; to enhance physical performance

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and beauty; to retard the aging process and prolong life; to treat specific symptoms like bone pain, lack of energy, memory loss, and poor sleep, to prevent and treat chronic diseases like obesity, cancers, diabetes mellitus, cardiovascular diseases, high blood cholesterol, and arthritis.^[1,8,9] Consequently, there exist massive varieties of dietary supplement products worldwide, with more than 30, 000 products in the United States alone.^[10]

The global dietary supplement industry has now grown intensely over the years, with millions of people worldwide from different socio-economic class taking diverse forms of dietary supplements on a regular basis.^[8] Approximately 40% to 50% of adults in the United States alone uses dietary supplements regularly, a practice that is increasing rapidly in most other countries of the world.^[9-11] Diet supplementation has now become a massive global multibillion-dollar business, accounting for about 31 billion dollars in the year 2018 in the United States alone.^[9,10] Also, the Western European nations spent up to £900 million in the year 2009 on over-the-counter slimming supplements alone.^[8] The global dietary supplements market was valued at USD 132.8 billion in the year 2016 and is expected to reach USD 220.3 billion by the year 2022, with an anticipated Compound Annual Growth Rate (CAGR) of 8.8% between 2017 and 2022.^[12]

Curiously, the Federal Drug Authority (FDA) of the United States, and the drug regulatory authorities of most countries still regulate dietary supplements as a sub-category of food, and are yet to enact strict policies and regulations regarding the long-term safety and therapeutic claims of some of these drugs.^[10,11] According to the World Health Organization (WHO), the dietary supplement industry has become a massive global business, producing thousands of products every year, with supposed health benefits – ranging from the scientifically proven nutritionally beneficial to the fictitious and fraudulent claims, and the number of such products is still soaring.^[7] Therefore, it is no longer possible for regulatory authorities, independent researchers, and relevant healthcare organizations, to ignore this rising global phenomenon of non-medical dietary supplements use, without providing evidence-based guidelines and recommendations.^[7] The objectives of this article are to investigate the health and therapeutic claims attributed to some dietary supplements, their safety concerns, and their possible role in modern healthcare.

METHODS

The review was based on the available English literature from electronic databases in Google search engine, Academia, ResearchGate, and MEDLINE database. The websites of reputable public health organizations and institutions, like the World Health Organization (WHO), Academy of Nutrition and Dietetics, Johns Hopkins University, Food and Drug Administration, Harvard School of Public Health, United Nations Children's Fund (UNICEF), National Institutes of Health, American Academy of Sport Dietitians and

Nutritionists, International Diabetes Federation, American College of Lifestyle Medicine, American Heart Association, Health Canada, American College of Physicians, etc., were also visited for relevant and current information. Some of the keywords that were searched include dietary supplements, diet supplementation, multivitamin and minerals, dietary supplements and chronic diseases, dietary supplements and safety concerns, etc. A total number of 4615 of articles were retrieved. They were visualized, profiled, cleansed, prepared, analyzed, and summarized, out of which 36 most relevant articles were utilized for the review.

Inclusion and exclusion criteria

The inclusion criteria were:

- Topics relating to dietary supplements and the role in modern healthcare practices
- Article type from review, case report and original research
- Articles published between 2000 and 2021
- Articles written in English language only.

The exclusion criteria were:

- Article type being editorial, letter to the editor and commentary.

The arguments supporting diet supplementation

Some have argued that although well-balanced healthy diets should contain all the essential micronutrients that are needed by the body to function optimally, their regular consumption is sometimes not achievable. This might be due to either inadequate knowledge, unavailability, unaffordability, or inaccessibility to these healthy diets. Also, cultural practices like overcooking, environmental factors like a poor storage facility, medical factor like Crohn's disease, social factors like peer pressure, and adverse agricultural practices, may all prevent adequate consumption of most MVMs from foods, even if the desire to do so is high.

Also, in-view of the wide therapeutic safety window of most micronutrients, and the available evidence from observational studies that shows the existence of some micronutrient deficiencies among a randomly selected large group of people, some experts have argued that the routine consumption of dietary supplements by most apparently healthy people may be clinically justified.^[13] Furthermore, the availability and adequacy of many micronutrients in the body are critical to the optimal functionality of most cells, allowing the cells to build the metabolic reserve needed to prevent or delay many diseases. Consequently, micronutrient supplementation may be a vital adjunct for a variety of preventive and therapeutic interventions.^[13]

Besides, some have argued that insufficient micronutrients may lead to cellular damages and increase the risk of congenital and chronic diseases. Getting enough B vitamins and folate, for instance, is especially important for women who may or aspire to become pregnant since adequate folate can help lower the risk of spina bifida or anencephaly in the

fetus.^[4] However, folate needs to be taken in the first few weeks of conception (often before the first sign or symptom of pregnancy) for it to be optimally effective.^[4] Therefore, regular diet supplementation with vitamin B and folate by women of childbearing age, might be essential to prevent congenital malformations. Some researchers have also informed that deficiencies in many other micronutrients can damage the DNA, the essential “blueprint” of each cell, which in turn can cause damages to the cells and accelerate the aging process. The damages may distort angiogenesis, the immune system, cell differentiation, cell proliferation, and apoptosis, and consequently increase the likelihood of developing infectious diseases due to compromised immunity, and chronic diseases like cancers, heart diseases, mental disorders, and increase mortality rates from different causes.^[4,5,14-17]

Furthermore, dietary supplements appear to be an effective insurance against diseases of deficiency. Regular consumption of dietary supplements may likely prevent or reduce the risk of developing some diseases of nutritional deficiency of historic concerns such as blindness (vitamin A deficiency), scurvy (vitamin C deficiency), beriberi (Thiamine – vitamin B1 deficiency), pellagra (Niacin – vitamin B3 deficiency), osteoporosis (calcium deficiency), rickets (vitamin D deficiency), anemia (iron and vitamin B12 deficiencies), and birth defect (folate deficiency).^[9] Considering these ‘valid’ reasons, some experts have recommended regular supplementation of the diet with MVMs by most people. Stating that there exists staggering evidence to support the regular consumption of dietary supplements, especially in modest doses.^[4]

The arguments against diet supplementation

Despite the simile brilliant defense in support of the use of dietary supplements, most experts in the field of nutritional and medical sciences are opposed to the ‘pill revolution’. They have warned that people should be cautious when it comes to supplementing the diet with MVMs, as such practice may lead to serious health consequences, especially on long-term use.^[18] This is premised on the fact that science is yet to clearly demonstrate the possible long-term health effects of regular consumption of most dietary supplements, while most available studies are also yet to show clear correlation between the consumption of most dietary supplements and the prevention and treatment of most chronic diseases and retardation of the aging process.^[18]

The few published studies that seem to support the use of dietary supplements in the management of some chronic diseases have been generally unconvincing, either because they are poorly conducted, or the researchers clearly exhibit conflict of interest.^[18] According to the National Institute of Health (NIH), there is presently no enough scientific evidence to support the widely claimed health benefits of some of these dietary supplements.^[8] Most times, the misconceptions about the grand benefits of dietary supplements appear not to be rooted in solid scientific discoveries, rather are products of

massive media reporting, vigorous marketing, and the sheer volume of misinformation floating around in the internet.^[8] Some of the specific arguments that have been submitted against diet supplementation are as follows:

The efficacy of some micronutrients and botanical compounds may decline if extracted out of food and consumed in isolation, as dietary supplements.^[18] Many micronutrients and botanicals in foods tend to be efficient only if consumed in their natural form in food where they are found in the right proportion and composition with the other micronutrients and botanical compounds. For instance, Lycopene (a phytochemical found in tomatoes and some other fruits and vegetables), is known for its well documented anti-cancer property. However, there is no convincing evidence that the anti-cancer property of the substance is sustained if given as dietary supplement.^[18]

Another example is the antioxidants (like vitamin C and E, selenium, and some carotenoids) which are abundantly found in vegetables and fruits. These antioxidants are widely documented to help protect against and fight some cancers, heart diseases and retard the aging process. However, based on available studies, antioxidants have not shown significant benefits in cardiovascular disease outcomes, cancer prevention or risk reduction, or glycemic control if taken in dietary supplement form.^[19,20] It appears that some micronutrients and chemical substances in foods, especially phytochemicals and antioxidants, need to work in synergy with other nutrients and chemical substances in food to be effective. Therefore, it may be impossible to isolate one or a few of thousands of compounds found in food and expect that isolate to work effectively independent of all the other nutrients that were originally part of the same whole food.^[18]

There also exist evidence that the long-term use of some micronutrients and chemical substances in food if taken in dietary supplement form cause more harm than good.^[21] For instance, the anti-cancer properties of carrot have been linked to an antioxidant it abundantly contained, called beta-carotene. However, most studies have implicated beta-carotene isolate or dietary supplement in the increased incidence of lung cancer and cardiovascular diseases among the people who regularly take it, especially among smokers.^[18] In fact, people who smoke have been specifically warned to avoid any dietary supplement that contains beta carotene.^[1]

Vitamin C supplements have been perceived by many as harmless and very safe for human consumption. However, according to a study, after taking 500 mg of vitamin C supplement every day for three weeks, the cellular DNA picture of the intervention group showed more damages compared to the control group who took only a placebo. Also, the DNA of the white blood cells in the intervention group appears to be disrupted after prolong intake of vitamin C supplements.^[18]

Furthermore, available evidence suggests that most plant-based foods contain more than 100, 000 nutrients and chemical compounds, and some of these, especially phytochemicals, are

yet to be identified or isolated.^[18,20] Still using Lycopene as an example, despite its well documented health benefits, it is only one of the possibly hundreds of beneficial chemical compounds found in tomatoes; scientists are yet to identify some of the other components in this vegetable.^[18] A dietary supplement brand that includes mainly Lycopene have missed out not only the already identified micronutrients, phytochemicals, and other botanical compounds that are found in tomatoes, but also the possible hundreds that are yet to be identified or isolated.^[18]

Moreover, there is insufficient evidence to recommend regular intake of dietary supplements to apparently healthy, at-risk, or to treat most chronic noncommunicable diseases (NCDs). The risks and benefits of taking daily dietary supplements have been studied extensively, and the United States Preventive Services Task Force and the International Diabetes Federation, stated categorically that based on their extensive research findings, there is insufficient scientific evidence to recommend regular dietary supplements, especially antioxidants, as a strategy to prevent or treat cancers, cardiovascular diseases, diabetes mellitus, and other chronic NCDs.^[18,19]

Besides, most vitamins and minerals can be derived naturally from regular food consumption, extra intake in the form of dietary supplements (especially the highly concentrated forms) might make the individual exceed the dietary tolerable upper intake levels (upper limits – UL) of some of the micronutrients, which in return can lead to unpleasant and sometimes hazardous adverse effects.^[1,4] Too much iron intake, for instance, can lead to multi-organ damage, especially in men and postmenopausal women, and such categories of people have been specifically warned to desist from such practice.^[1] Also, taking high levels of the fat-soluble vitamin A and D for a prolonged time has been clearly associated with vitamin A and D toxicity in some people.^[9] The intake of >1,500 mg/day of Vitamin A as retinol in postmenopausal women, have been associated with reduced bone mineral density and increased risk of future hip fracture, while the excessive and prolong intake of vitamin B-6 supplements have been noticed to result in sensory neuropathy in some people.^[1] According to the Health Professionals Follow-Up Study, men who took a high dose (>100 milligrams/day), or a normal dose of zinc supplements for a relatively long period of time, were at higher risk of developing prostate cancer compared to the control group.^[22] Some vitamins and minerals once taken beyond their UL can also lead to adverse effects like fatigue, hair loss, kidney stones, liver damage, nerve damage, and birth defects.^[9]

Moreover, a good number of people who take dietary supplements usually do so in combination with other supplements, herbs, or other conventional medicines. Studies have shown that such practice can lead to potential nutrient-nutrient and drug-nutrient interactions, thereby leading to reduction or increase concentration or bioavailability of the nutrients or drugs.^[1,23] For instance, high-dose iron supplements can decrease zinc absorption in the body, high-dose zinc can inhibit copper absorption, while the

absorption of iron is inhibited by calcium supplements.^[1] High doses of vitamin E (usually >400 IU) and vitamin K may interfere with the functions of anticoagulant medications.^[1] While the consumption of St John's Wort, a popular herbal supplement, may lead to about 57% reduction in the serum level of Indinavir, an antiviral drug.^[23] Also, herbs like *kava* and *valerian* act as sedatives and can enhance the effects of anesthetics and other medications used during surgery.^[11] Proton pump inhibitors may also interfere with vitamin B-12 absorption.^[1] Corticosteroids may deplete serum calcium level and impair vitamin D metabolism; while some diuretics, antibiotics, and proton pump inhibitors can reduce the absorption of magnesium. Consequently, apart from the fact that the practice of polypharmacy can result in unnecessary pills burden and reduce adherence to possibly life-saving prescribed medications, it can paradoxically result in the deficiency of some essential and non-essential micronutrients.^[1]

There is also some evidence that the regular consumption of some dietary supplements may worsen an existing health condition or interfere with a medical/surgical procedure. Bleeding is a potential side effect of garlic, Ginkgo Biloba, ginseng, and vitamin E, so can be hazardous to health if taken as dietary supplements in post-surgical cases.^[11] Glucosamine may mimic human insulin, and may artificially cause hypoglycemia during surgery or in diabetic patients on anti-hyperglycemic drugs.^[11] Chondroitin supplements users may suffer from bleeding complications during surgery, particularly when used in combination with blood-thinning medications.^[11]

Also, *Echinacea* is an herb that is often used in the prevention and treatment of viral, bacterial, and fungal infections, as well as for chronic wounds, ulcers, and arthritis.^[11] However, it can trigger immunosuppression, causing poor wound healing and infection, especially in patients that are already unwell or immunocompromised.^[11] *Ephedra* is yet another example, this herbal supplement has been documented to promote weight loss, increase energy and treat respiratory tract conditions such as asthma and bronchitis, but the use of the herb has been banned by the FDA because it has been noticed to have the potential of raising blood pressure, heart, and metabolic rates, ultimately causing heart attacks, heart arrhythmia, stroke, and even death.^[11]

In addition, there seems to exist high deception and fraudulent practice in the dietary supplement industry. The claims of some dietary supplements of being “all-natural” or “only herbal product”, so should be completely harmless cannot be substantiated.^[11] Furthermore, these claims may be deceptive or misleading because the term ‘natural’ is a general claim that implies that the dietary supplement is extracted directly from foods and nothing artificial has been added. This might not be totally true as some of them contain preservatives to increase their shelf life.^[11] Also, it has been discovered that some of the health claims of some dietary supplement brands are fraudulent as they are not backed by solid scientific studies,

while some of their claimed ingredients are actually not included.^[11] Moreover, in most instances, the ‘pseudo-medical’ used terms while describing health benefits of many of these dietary supplements, such as ‘detoxify,’ ‘energize,’ and ‘purify,’ are not only vague claims that are hard to measure scientifically, many times they are fictitious.^[11]

For these reasons, some nutritional and medical scientists, have strongly recommended that until more is known about the interaction of dietary supplements with the body and other drugs, and their long-term safety concerns are well documented, it is advisable to concentrate on deriving all needed nutrients from whole foods and people should only consider consuming MVMs if there is clear clinical evidence of the existence of a disease of deficiency, or their daily nutritional needs cannot be met from healthy diets, and even such should be prescribed and monitored by certified healthcare professionals.^[1,18]

Studies on the use of dietary supplements in health promotion and disease prevention

Although empirical evidence has been submitted in support or against the use of dietary supplements, the results of some well-designed studies on the effects of dietary supplements on the body are worth reviewing. The Iowa Women’s Health Study is a cohort study that was conducted for 22 years among 38, 772 older (mean age of 61.6 years) Iowa women with the aim of investigating the long-term health effects of some dietary supplements (vitamin B6, folic acid, iron, magnesium, zinc, calcium and copper) on chronic disease prevention and total mortality. The result revealed that except for calcium, the use of the dietary supplements was directly associated with significantly increased risk of total mortality among the participants.^[24]

The Physicians’ Health Study II, a large scale, double-blind, placebo-controlled randomized trial was conducted for 14 years with the aim of investigating the effects of long-term use of dietary supplements (vitamin E, vitamin C, and Beta carotene) on the incidence of general body cancers and site-specific cancer events among men (mean age of 64.3 years). After a median follow-up of 11.2 years, 2, 669 of the study participants developed confirmed cancers, including 1, 373 cases of prostate cancer and 210 cases of colorectal cancer. There was no significant protective effect of daily multivitamins use on the incidence rate of prostate cancer, colorectal cancer, or other site-specific cancers. There was also no significant difference in the risk of cancer mortality.^[25]

Multinational double-blinded randomized controlled trial called ‘the Selenium and Vitamin E Cancer Prevention Trials’ (The SELECT 1 and SELECT II Trials) was conducted among 35, 533 relatively healthy men for 7 years with the aim of determining whether the anti-oxidants supplements (selenium, vitamin E or both) could prevent prostate cancer and other diseases (SELECT I Trial). The results showed that the consumption of selenium or vitamin E, alone or in combination did not significantly prevent prostate cancer in the study population after 7 years.^[26] A follow-up

study after another 3 years (SELECT II Trial), discovered that diet supplementation with vitamin E even significantly increased the risk of prostate cancer by 17%.^[27]

A meta-analysis, titled ‘Mortality in Randomized Trials of Antioxidant Supplements for Primary and Secondary Prevention’ involved 68 randomized primary and secondary prevention trials with 232, 606 participants.^[28] Its aim was to assess the effects of some antioxidant supplements (beta carotene, vitamin A, vitamin C, vitamin E, and selenium) singly or in combination on mortality. The results revealed that none of the dietary supplements had a significant effect on mortality reduction. Multivariate meta-regression analyses of the study further revealed that the ‘low-bias risk trials’ containing selenium supplements were even significantly associated with higher mortality. After exclusion of selenium, beta carotene, vitamin A, and vitamin E, singly or combined, from the trials, there was still significantly increased mortality in the participants, although the ‘vitamin C and selenium only trials’ had no significant effect on mortality.^[28]

Recommendations on diet supplementation

There exist some valid reasons why some people may need to supplement their diets with MVMs. Some of these reasons can be seen in Table 1.^[1,2,4,8,9,29-32]

The National Institute of Health (NIH) warned that any anybody that is not captured in Table 1 but still consume dietary supplements on a regular basis, may not only be wasting their hard-earned money on an excess amount of MVMs that are already gained in the diet, such practice might even lead to unpleasant and sometimes hazardous side effects.^[11] Even in the prevention and treatment of the recent Coronavirus disease 2019 (COVID-19), current clinical evidence discourages the routine use of dietary supplements unless there is a confirmed or suspected micronutrients deficiency (like hypovitaminosis C and D, and Zinc deficiency).^[33-35] Regardless of the reasons, people that regularly consume dietary supplements, should be guided by the principles in Table 2.^[1,8,9]

CONCLUSION

There is incontrovertible evidence to support the claim that regular intake of multiple vitamins and minerals is associated with significant health benefits, and in the prevention and treatment of many diseases, either diseases of deficiency, communicable, or non-communicable diseases. However, most well-conducted researches demonstrate that such benefits are best accrue from the regular consumption of healthy diets, and not from dietary supplements. As reasoned by the American College of Physicians (ACP), “although available evidence does not negate some health benefits in a small sub-group of people, we believe that the case is closed – supplementing the diet of well-nourished adults with (most) MVMs has no clear benefit and might even be harmful.”^[36]

The present massive scientific evidence on the ineffectiveness and potential health hazards of dietary supplements has

Table 1: Evidence-based recommendations for diet supplementation

Categories	Recommended dietary supplements
Women	
All women of childbearing age (15-45 years)	400-800 micrograms of folic acid daily
Pregnant or lactating woman	Iron, Folate, and vitamin D regularly
Post-menopausal women	Vitamin D and Calcium regularly
Women with heavy menstrual bleeding	Iron and Vitamin C regularly
Children	
Newborns	Vitamin K
Aged 6 months-5 years	May need vitamins A, C, D, Fluoride, and Iron after medical assessment
Healthy youth and adults	
Dark skinned people and people who are not regularly exposed to sunlight	May need 1,000 to 2,000 IU of vitamin D daily after medical assessment
Elderly people (≥ 50 years)	Vitamin B12 (2.4 mg/day), vitamin D (400-1, 000 IU/day), and Calcium
People with specific health conditions	
People with specific micronutrient deficiencies	Take the deficient micronutrients
People with lactose intolerance	May need Calcium regularly
Strict vegetarians	Vitamins B 12, D, Iron, and Zinc
Illicit drugs addicts, tobacco use, alcohol abuse	May need basic MVMs regularly
Post-surgery, weight-loss surgery, burns, injury, or prolonged illnesses	May need basic MVMs regularly
People taking medications that interfere with the body's use of certain nutrients	Take the implicated micronutrients
Patients with established cardiovascular diseases	May need fish oil capsules (1-4 g/day)
Patients with persistent anorexia	May need basic MVMs regularly
Patients with compromised immunity	May need basic MVMs regularly
Athletes	
Vegetarian athletes	MVMs based on their nutritional needs
Endurance athletes	Vitamins C, D, E, Magnesium, Iron and Calcium based on their nutritional needs

Table 2: General guiding principles in using dietary supplements

Principles	Recommendations
Not a substitute	They should never be viewed as replacements for healthy diets and lifestyles. They should not replace prescribed medications or routine health assessments.
Simplicity	Avoid "mega" doses. They should be simple in number and dosage. They should contain ≤100% Dietary Value (DV) for people's age and gender.
Supervision	Their use should be supervised by certified healthcare practitioners. Their expiration date should be checked on a regular basis
Time-bound	Their use should have a time limit unless otherwise stated by the certified healthcare practitioners.
Economical	Unless otherwise specified, people should purchase the generic brands and avoid the extra and unnecessary ingredients that add to the cost.

important clinical and public health implications.^[36] The present evidence is strong enough for clinicians to take action and advice against routine diet supplementation in healthy adults with no clear clinical indication.^[33] Whereas, public health policymakers should focus their efforts on developing policies, programs, materials and methods that encourage healthy diets and lifestyles among the general population. Furthermore, government should develop more stringent

regulations as regarding the advertisement, health claims, and long-term safety of some of these dietary supplements. Finally, more researches and investments should be dedicated to the evolving field of dietary supplement use in modern healthcare. As there may be more baffling and fascinating discoveries along the pathway, particularly as the science of nutrition and diet supplementation continue to evolve.^[4]

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Conflicts of interest

There are no conflicts of interest.

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