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A Systematic Review: Do We Really Need Multivitamin and Mineral Supplements to Stay Healthy?

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Abstract Over-the-counter dietary supplements are big business — the Indian dietary supplements market reached a value of INR 331 Billion in FY21 according to a report by EY India released on 18 February, 2022. Looking forward, IMARC Group expects the market to reach INR 847 Billion by 2027, exhibiting a compound annual growth rate of 14% during 2022-2027. However, the question remains whether using these supplements is actually beneficial to health or not. This article reviews the results of randomized controlled trials and observational studies of multivitamin and mineral supplements among the general adult population to answer the question of whether they are beneficial to overall health or not. The PubMed, Scopus, and Web of Science databases were used for the literature search. Randomized controlled trials and observational studies in adults were reviewed to assess efficacy and safety. Our study found that taking multivitamin and mineral supplements can increase nutrient intakes and help people obtain recommended amounts of vitamins and minerals when they do not meet these needs from natural food alone. Some individuals, including vegetarians, vegans, and strict dieters need to make sure they're getting enough vitamin B12, calcium, iron, and zinc from their natural diet. Suppose if they don't get the recommended amounts of certain vitamins or minerals from their diet, multivitamin and mineral supplements may help them obtain those nutrients. The study also discovered that using multivitamins and supplements can promote brain functions and support eye health. But more research is needed in this area to ensure its benefits. We do not have sufficient evidences to prove the presence or absence of benefits from use of multivitamin and mineral supplements to prevent chronic diseases such as heart diseases and cancer.

Keywords: *dietary supplements, food supplements, multivitamin, vitamins, minerals*

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1. Introduction

Multivitamins and Mineral Supplements (MMS) are the most commonly used supplements in the world [1]. Their popularity has increased rapidly in the past few decades [2].

However, do healthy individuals really need multivitamins and mineral supplements to stay healthy? Are these supplements beneficial for increasing nutrient intakes, promoting brain functions, promoting eye health or preventing chronic disease such as heart disease and cancer? Are there any health risks associated with multivitamin and mineral supplements?

This article examines the scientific evidences behind multivitamin and mineral supplements in general adult population to answer the question of whether they are beneficial to overall health or not.

1.1. Vitamins and Minerals

Vitamins and minerals are micronutrients required by the body in small amounts to work properly and stay healthy. Your body also needs these nutrients for reproduction, maintenance, growth, and the regulation of bodily processes. Most people get all the vitamins and minerals they need by eating a healthy, balanced diet [5].

Vitamins are organic substances that are generally classified as either fat soluble or water soluble. Fat-soluble vitamins (vitamin A, vitamin D, vitamin E, and vitamin K) dissolve in fat and tend to accumulate in the body. Water-soluble vitamins (vitamin C and the B-complex vitamins, such as vitamin B6, vitamin B12, and folate) must dissolve in water before they can be absorbed by the body, and therefore cannot be stored. Any water-soluble vitamins unused by the body are primarily lost through urine [6].

Minerals are inorganic elements present in soil and water, which are absorbed by plants or consumed by animals. While you're likely familiar with calcium, sodium, and potassium, there is a range of other minerals, including trace minerals (e.g. copper, iodine, and zinc) needed in very small amounts [6].

1.2. Dietary Supplements

A dietary supplement is a manufactured product intended to supplement one's diet by taking a pill, capsule, tablet, powder, chewable gummies, or liquid [9]. A supplement can provide nutrients either extracted from food sources or that are synthetic in order to increase the quantity of their consumption [9].

Dietary supplements are minimally regulated and do not need a prescription. These factors, together with their broad distribution, create a positive environment for growth in their market [3]. The internet provides access to information about dietary supplements and allows their easy purchase [1]. Some people believe that multivitamins can improve health, compensate for poor eating habits, and even reduce your risk of developing chronic diseases [4].

1.3. Multivitamins and Mineral Supplements

Multivitamins and minerals (MMS) are supplements that contain many different vitamins and minerals, sometimes alongside other ingredients. People use the term "multivitamins and mineral supplement" to mean an individual vitamin or mineral preparation or a multivitamin that contains two or more vitamins, minerals, or both [7].

Vitamins and minerals are important for your body to stay healthy. Your body uses minerals for many different jobs, including keeping your bones, muscles, heart, and brain working properly. Minerals are also important for making enzymes and hormones [8].

MMS may contain many of these vitamins and minerals — but in varying amounts. They may also contain other ingredients like herbs, amino acids, and fatty acids. Some supplements may contain ingredients that can interact with medications. The nutrients in multivitamins may be derived from real foods or can be made synthetically [9].

MMS are made in many forms, including tablets, capsules, chewable gummies, powders, and liquids. They are available in pharmacies, large discount stores, and supermarkets, as well as online stores. Given that there's no standard for what constitutes a multivitamin, their nutrient composition varies by brand and product [10].

MMS use is also more common among the children of women who take supplements; older adults; individuals with more education, a higher income, a healthier lifestyle and diet, and lower body-mass index (BMI); and residents of the western areas [10]. People with healthier diets and lifestyles are more likely to use dietary supplements [14].

1.4. Types of Multivitamins and Mineral Supplements

Many types of MMS are available in the marketplace. One way to group them is as follows:

Types	Description
Basic	MMS taken once a day that contain all or most vitamins and minerals, most in amounts that do not exceed the Daily Values (DVs), Recommended Dietary Allowances (RDAs), or Adequate Intakes (AIs) for these nutrients. This type focuses primarily on these basic, broad-spectrum MMS. Formulations for children, adult men and women, pregnant people, and seniors typically provide different amounts of the same vitamins and minerals to meet the needs of these populations.
High potency	Some MMS contain amounts of some vitamins and minerals that are substantially higher than the DV, RDA, AI, or even, in some cases, the established Tolerable Upper Intake Level (UL). These MMS might also include other nutrients and botanical ingredients. Manufacturers sometimes offer these MMS in packs of two or more pills for users to take daily.
Specialized	MMS—such as those for energy, enhanced athletic performance, weight control, improved immune function or eye health—often combine several vitamins and minerals with botanical and specialty ingredients, such as coenzyme Q10, probiotics, or glucosamine. Some of these products might contain amounts of nutrients that are substantially above the DV, RDA, AI, or even UL. These MMS are condition specific.

National Institutes of Health, Office of Dietary Supplements. Dietary Supplement Fact Sheet for Health Professionals, Multivitamin/mineral Supplements – Health Professionals.

1.5. Importance of this Study

Over-the-counter dietary supplements are big business — the Indian dietary supplements market reached a value of INR 331 Billion in FY21 according to a report by EY India released on 18 February, 2022. Looking forward, IMARC Group expects the market to reach INR 847 Billion by 2027, exhibiting a compound annual growth rate of 14% during 2022-2027.

But are multivitamin and mineral supplements a good investment or a waste of money? Are these supplements really beneficial for increasing nutrient intakes, promoting brain functions, promoting eye health or preventing chronic disease such as heart disease and cancer? Are there any health risks associated with multivitamin and mineral supplements?

This article reviews the results of randomized controlled trials and observational studies of multivitamin and mineral supplements among the general adult population to answer the question of whether they are beneficial to overall health or not.

1.6. Objectives

This systematic review was designed with following objectives:

1. To investigate whether using multivitamin and mineral supplements can increase nutrient intake in general adult population
2. To investigate whether using multivitamin and mineral supplements can promote brain functions in general adult population
3. To investigate whether using multivitamin and mineral supplements can support eye health in general adult population
4. To investigate whether using multivitamin and mineral supplements can prevent heart diseases in general adult population

5. To investigate whether using multivitamin and mineral supplements can prevent cancer
6. To investigate whether using multivitamin and mineral supplements can lead to side effects or cause health problems in general adult population.

2. Methods

The purpose of this systematic review is to examine the results of randomized control trials and observational studies of multivitamin and minerals supplements in general adult population to find out whether taking multivitamins and minerals supplements is beneficial to overall health or not.

We defined Multivitamin and Mineral Supplements as any supplements that contain 3 or more vitamins and at least one mineral. We defined the general population as community-dwelling persons who do not have special nutritional needs. We defined prevention as an action taken to prevent the development of a disease in persons who are well and do not have the disease in question.

The PubMed, Scopus, and Web of Science databases were used for the literature search. Randomized controlled trials and observational studies in adults were reviewed to assess efficacy and safety. The search strategy was based on a careful selection of keywords pertaining to dietary supplements, food supplements, multivitamins, vitamins, minerals, nutrition, weight loss and wellness supplements. The filter for research involving humans only was activated and the search was conducted to obtain articles published between 1980 and 2022.

Because the results of literature review articles can be affected by many types of bias, we made every effort to minimize it to ensure that the methods they used were appropriate. Steps to assess the risk of bias in original research articles included looking at how study participants were assigned to treatment groups and whether patients and/or study assessors were blinded to the treatment given.

3. Results

After title review, we identified 3710 potentially eligible articles through abstract review. After screening full text, total 48 articles met the eligibility criteria. The articles on the single-nutrient supplements are not included in this report. We also sourced 6 articles from government websites. Each eligible article was reviewed by paired reviewers.

People use multivitamin and mineral supplements for various reasons including increasing nutrient intakes, promoting brain function, promoting eye health, and preventing chronic diseases such as heart diseases and cancer [10].

Thus, we have summarized the evidence on the use of MMS for above mentioned reasons.

3.1. Nutrient Intake

Taking multivitamin and mineral supplements can increase nutrient intakes and help people obtain recommended amounts of vitamins and minerals when they do not meet these needs from food alone [11,12]. Some individuals, including older adults, vegetarians, and vegans, may need higher amounts of certain vitamins or minerals [41].

A varied diet generally provides enough of each vitamin and mineral [5]. However, some people may need supplements to correct vitamin or mineral deficiencies [41].

Vegetarians, vegans, crash dieters, strict dieters, pregnant women, breastfeeding women, illegal drug addicts, older adults, chronically ill people, women with heavy periods, people with food allergies and those with malabsorption problems such as diarrhea, coeliac disease, cystic fibrosis or pancreatitis may need supplements to correct vitamin or mineral deficiencies [41].

According to the Food and Nutrition Board (FNB), the Recommended Daily Allowances (RDAs) and Adequate Intakes (AIs) for nutrients are levels of intake to ingest, on average, each day from the diet [13]. The FNB does not address whether or to what extent nutrient supplements can compensate for dietary inadequacies. However, some users consider use of MMS as a form of “nutritional insurance” [14]. MMS can also increase the likelihood that users will have intakes of some nutrients that are higher than the ULs [15]. Excess nutrient intakes are even more likely among MMS users who also take single vitamin and mineral supplements [16].

In one study, for example, investigators assessed the diets and use of MMS in a large multiethnic cohort of 90,771 men and women ages 45 and older from Los Angeles and Hawaii [17]. The investigators calculated nutrient intakes from participants’ diets using a food frequency questionnaire and from MMS (taken by 23%) using the nutrient composition of two commonly used MMS. Approximately 74–76% of the men and 72–75% of the women had adequate intakes on average from food alone of the 17 nutrients examined, but use of MMS increased the prevalence of adequacy to 84% for the men and 83% for the women. The greatest improvements in intake were for vitamins A and E and zinc. However, MMS users had excessive intakes of several nutrients; 10–15% had excessive intakes of vitamin A, iron, and zinc, and 48–61% had excessive intakes of niacin.

Several studies have found that MMS users tend to have higher micronutrient intakes from their diet alone than nonusers [16]. The populations at highest risk of nutritional inadequacy may benefit the most from MMS [18].

3.2. Cancer

Evidence is insufficient to prove the presence or absence of benefits from use of multivitamin and mineral supplements to prevent cancer.

The evidence regarding MMS use and cancer risk is mixed. Some studies suggest no effect on cancer risk, while others link multivitamin use to increased cancer risk [19].

One review examined five randomized controlled trials including 47,289 people. It found a 31% lower risk of cancer in men who took multivitamins, but no effect in women [20].

Two observational studies, one including only women and the other including both men and women, tied long-term multivitamin use to a reduced risk of colon cancer [21].

The Physicians' Health Study II noted that long-term, daily multivitamin use reduced cancer risk in men with a history of cancer, as well as those with no history of the disease [22].

Most studies of MMS that have focused on cancer have been observational. They have examined associations between MMS use and overall cancer risk or risk of various types of cancer (including breast, prostate, and colon cancer) as well as associations with cancer-related death.

3.3. Heart Diseases

There is insufficient evidence to claim the presence or absence of benefits from use of multivitamin and mineral supplements to prevent heart diseases.

While some experts believe that taking MMS can help prevent heart disease, possibly because certain nutrients in these products might reduce blood pressure or affect vascular function, research doesn't seem to support it conclusively.

Some studies suggest that multivitamins are correlated to a reduced risk of heart attacks and death, while others show no effects [23,24,25].

The Physicians' Health Study II investigated the effects of daily multivitamin use in over 14,000 middle-aged male doctors for over a decade and found no reductions in heart attacks, strokes, or mortality [22].

However, a more recent study revealed that among women — but not men — taking a multivitamin for more than 3 years was linked to a lower risk of dying from heart disease [26].

3.4. Brain Function

Several small studies examining specific populations have found that multivitamins can improve memory in older adults [27,28,29].

Multivitamins may also affect your mood. Research has not only revealed links between poor mood and nutrient deficiencies but also between nutritional supplements and reduced symptoms of anxiety and depression [30].

However, other studies reveal little to no changes in mood [31].

3.5. Eye Health

One study found that taking antioxidant vitamins and minerals may slow its progression and help prevent it [32].

Some evidence indicates that multivitamins may reduce your risk of developing cataracts, another widespread eye disease [33,34].

3.4. Health Risk

Supplementing with large doses of certain nutrients can have harmful effects to health. This is more likely to occur if you take a high-potency multivitamin on top of a nutrient-dense diet.

Dosage is an essential factor to consider when taking multivitamins. Although high doses of some vitamins and minerals are acceptable for some people, high amounts can be harmful.

The appropriate dosage can depend on a vitamin's solubility. Your body flushes out excess amounts of water-soluble vitamins through your urine. Since your body has no easy way to get rid of fat-soluble vitamins, excess amounts may accumulate in your liver [6].

Pregnant people need to be especially careful with their vitamin A intake, as excessive intakes have been linked to congenital disabilities [35].

Vitamin D toxicity is rare and unlikely to develop from multivitamin use. However, vitamin A toxicity is more common [36,37].

If you take MMS and eat many nutrient-dense foods, you could exceed the recommended daily intake of many nutrients.

Smokers should avoid multivitamins with large amounts of beta carotene or vitamin A, as these nutrients may increase your risk of lung cancer [38].

High doses of certain minerals, such as iron, can lead to stomach upset, constipation, vomiting, and fainting. Iron can also limit the body's ability to absorb zinc [39].

Particularly, men should be mindful of their iron consumption, as they tend to store more of it than women do, as well as individuals who have hemochromatosis. This condition can lead to a buildup of toxic levels of the mineral and may cause liver cirrhosis, liver cancer, and heart disease. Those with this condition should also avoid vitamin C supplements [39].

Another risk is faulty manufacturing processes, which may cause multivitamins to harbor much larger amounts of nutrients than intended [40].

4. Conclusion

The purpose of this systematic review is to examine the results of randomized control trials and observational studies of multivitamin and minerals supplements among the general adult population to find out whether taking multivitamins and minerals supplements is beneficial to overall health or not.

Previous studies found that there was no overall health benefit from taking multivitamin and mineral supplements [4,42]. Our study found that taking multivitamin and mineral supplements can increase nutrient intakes, promote brain functions, and support eye health.

Our study found that taking multivitamin and mineral supplements can increase nutrient intakes and help people obtain recommended amounts of vitamins and minerals when they do not meet these needs from natural food alone. Some individuals, including vegetarians, vegans, and strict dieters need to make sure they're getting enough vitamin B12, calcium, iron, and zinc from their natural diet. Suppose if they don't get the recommended amounts of certain vitamins or minerals from their diet, multivitamin and mineral supplements may help them obtain those nutrients.

However, supplementing with large doses of certain nutrients can have harmful effects to health. This is more likely to occur if you take a high-potency multivitamin on

top of a nutrient-dense diet. In other words, if you eat a healthy, balanced diet + take multivitamin and mineral supplements, you could exceed the recommended daily intake of many nutrients. High doses can cause health problems. Dosage is an essential factor to consider when taking multivitamins.

The study also discovered that using multivitamins and supplements can promote brain functions and support eye health. But more research is needed in this area to ensure its benefits.

We have insufficient evidences to prove the presence or absence of benefits from use of multivitamin and mineral supplements to prevent chronic diseases such as heart diseases and cancer. While some studies indicate that people who take multivitamins have a lower risk of heart disease and cancer, others have found no connection. Overall, the evidence is mixed.

5. Takeaways

1.1. Most people should get all the nutrients they need by having a varied and balanced diet, although some people including vegetarians, vegans, and strict dieters may need to take dietary supplements.

1.2. Taking a multivitamin mineral supplement is not a substitute for a balanced, healthful diet. Overall, it's key to remember that taking a multivitamin won't replace healthy habits.

1.3. No supplements can beat the nutrient power of a healthy diet. Supplements should never be used in place of real food.

1.4. Supplements are not a shortcut to better health and the prevention of chronic diseases. Even though supplements are popular, there is limited evidence that they offer any significant health benefits.

1.5. The greatest issue with supplements is that they are not regulated by the FDA. Supplements can appear on the shelf without having to prove they offer any benefits. With limited regulation and oversight, it's also difficult to know for certain that the supplement contains the ingredients on the label and is free of contaminants.

1.6. Supplementation can also result in large doses of a single vitamin being eaten 'alone.' When vitamins are consumed from foods, they have many companions to help them along the way. For instance, vitamin A (beta-carotene) in food is accompanied by hundreds of its carotenoid relatives. It is the combination of a whole range of compounds in foods that gives us the protection.

1.7. Multivitamins are generally safe for most people. But there are some risks for certain individuals. For example, people who are smokers or former smokers a multivitamin with a large amount of vitamin A, as it may increase the risk of lung cancer.

1.8. For a healthy adult, if supplements are used, they should generally be taken at levels close to the RDI. High-dose supplements should not be taken unless recommended under medical advice.

1.9. Vitamin and mineral supplements can also interfere with prescription medicines and medical treatments.

1.10. It is important to speak with the healthcare provider before taking any supplements because a supplement's effectiveness and safety may depend on your individual situation and health.

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