**A Scientific Review of the Myths and the Facts about the Nutritional Supplements**

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**Introduction**

There is a wide gap between what science says and what the consumers believe, about the effectiveness of the various nutritional supplements. The manufacturers of these products make extravagant promises about the properties of their drugs, but most of these claims are not backed up by any genuine clinical research.

In this is the era of evidence based medical practice, such irrational usage of drugs by the practitioners amounts to unethical practice. This not only causes wastage of money of the unsuspecting people, but also can be detrimental to their health.

Most of these are intensely marketed directly to the people and almost available over the counter, making its usage difficult to regularize.

**Immunity from regulations**

**Supplements manufacturers do not have to prove that their products are safe.** In the past, they had to prove to the Food and Drug Administration that their products were safe. Under current law, however, it has become the responsibility of the FDA to prove that a supplement is unsafe. With the high number of new supplements coming onto the market and the limited resources of the FDA, it is very likely that a product could cause harm before the FDA can take action. In addition, even after the FDA has declared a supplement unsafe, they then have to prove that the supplement is unsafe in the court of law. [1] To make the situation worse, no sale license from FDA is required for the sale of the Ayurvedic remedies in India. [2]

Hence there is an intense need to scientifically scrutinize each of them for their actual therapeutic effects.

**Vitamins**

Vitamins are organic substances, or groups of related substances, found in foods. They have specific biochemical functions and are generally not made in the body (or not in a sufficient quantity). The effects of vitamins are best known by their deficiency syndromes, many of which may be life threatening.

**The Myths**

*“If a tiny amount of something is good, then more is better and a lot is best.”*

*“These are natural substances, so they must be safe in any quantity”*

**The Facts**

In 2008, a review of all existing studies involving more than 230,000 people receiving supplemental antioxidants found that vitamins *increased* the risk of cancer and heart disease. [3] They concluded, "Based on existing evidence, we see little justification for the general and widespread use of dietary supplements."

University of Minnesota in 2011 published a study of the data of 38772 women and concluded that those taking multivitamin supplements, had *more risk of death* compared to those who did not. [4]

The important studies related to the usage of the various vitamins, as nutritional supplements are reviewed.

**Vitamin A**

In 1994, the National Cancer Institute, in collaboration with Finland's National Public Health Institute, studied 29,000 men, all long-term smokers more than fifty years old. Subjects were given vitamin E, beta-carotene, both, or neither. The results were that those taking vitamins and supplements were **more *likely to die*** from lung cancer or heart disease than those who did not take them -- the opposite of what researchers had anticipated. [5]

A study of administration of Vitamin A & beta-carotene on 18000 people exposed to asbestos, had to be stopped as they were dying from cancer and heart disease at rates 28 and 17 percent *higher*, respectively, than those who didn't. [6]

A meta-analysis of 43 studies showed that vitamin A supplementation of children less than five years who are at risk of deficiency reduces mortality by up to 24% [7]

**Vitamin B1**

Thiamine (B1) ameliorates the consequences of cerebellar damage and improves some brain functions typically associated with the frontal lobe in individuals being treated for alcoholism and malnutrition [8], [9]

**Vitamin B2**

Folate (B9) in pregnant women is beneficial to prevent spina bifida in the newborn [10]

**Vitamin B3**

Niacin (vitamin B3) in large doses for the treatment of high cholesterol where other therapies have failed (although niacin is poorly tolerated by many individuals, and can cause serious side effects). [11]

**Vitamin B12**

Vitamin B12 has proved to be beneficial in older people suffering from pernicious anemia [12]

It is recommended in vegetarians to prevent deficiency [13]

**Vitamin C**

Linus Pauling was a double Nobel laureate (Chemistry, 1931 & Peace 1962) who, at the age of 65, became the biggest champion for promotion for Vitamin C. He advocated administrating vitamin C in dosages of 3000mg to 18000mg per day, ie. 300 times more than its Recommended Daily Allowance (RDA), to treat flu and common cold. When these claims did not stand the test of scientific review, he advocated adding massive dosages of Vitamin A (25000 IU), Vitamin E (400 to 1600 IU), Selenium and Beta Carotene. Using the above alone, he claimed to cure heart diseases, mental illness, pneumonia, hepatitis, polio, tuberculosis, aging, shock, fractures, rabies, snakebites, AIDS etc. [14] But later, every systematic scientific study using big sample sizes, falsified these claims [15]

Many proved that those taking vitamins and supplements were *more likely to die* from diseases like cancer and heart diseases.[4],[5],[6],[16],[17]

**Vitamin D**

Of all the vitamins, vitamin D has been most extensively studied and has been found to have many beneficial effects in supra-nutritional doses, including preventing and treating osteoporosis in susceptible individuals. [18] The natural substance, cholecalciferol (D3), is the main active component of the various forms of vitamin D, the most usual source of which is sunlight. Vitamin D can be supplemented in susceptible individuals to prevent osteoporotic fractures.

**Vitamin E**

In 2005, researchers from Johns Hopkins School of Medicine evaluated nineteen studies involving more than 136,000 people and found an *increased risk of death* associated with supplemental vitamin E. [19]

A study published in the Journal of the American Medical Associationevaluated more than 9,000 people who took high-dose vitamin E to prevent cancer. Those who took vitamin E were more*likely* to develop heart failure than those who did not. [20]

**Vitamin K**

Is recommended for all newborns to prevent hemorrhagic disease [21]

**The Antioxidant Paradox:**

It is known that the free radicals damage the cells and people who eat diets rich in substances that neutralize free radicals are healthier. But in all the clinical studies, supplemental antioxidants showed that they were harmful.

Death rates were found to be *6% higher*, in fourteen randomized trials involving more than 170,000 people who took vitamins A, C, E, and beta-carotene to see whether antioxidants could prevent intestinal cancers. [16]

The most likely explanation is that free radicals aren't as evil as advertised. Although it is clear that free radicals can damage DNA and disrupt cell membranes, that's not always detrimental. Free radicals also kill bacteria and eliminate new cancer cells. So when people take large doses of antioxidants, the balance between free radical production and destruction might tip too much in one direction, causing an unnatural state in which the immune system is less able to destroy abnormal cells and organisms. Researchers have called this *"the antioxidant paradox".*

Whatever the reason, the data is clear: High doses of vitamins and supplements *increase the risk* of heart disease and cancer. For this reason, not a single national or international organization responsible for public health recommends them.

**Minerals:**

A study on 39000 older women, who took supplemental multivitamins, magnesium, zinc, copper, and iron showed that they *died at rates* *higher* than those who didn't. [4]

**[ TABLE 1 ]**

Researchers from the Cleveland Clinic published the results of a study of 36,000 men who took vitamin E, selenium, or both, and concluded that those receiving vitamin E had a 17 percent greater risk of prostate cancer. [17]

**Calcium**

A meta-analysis of RCTs involving 19 studies showed that Calcium supplementation had *no effect* on bone mineral density of children at the femoral neck or lumbar spine and a small effect on total body bone mineral content. [22]

In post menopausal women Calcium supplementation has a beneficial effect on bone density and may reduce vertebral fractures. It has no clear effect on non-vertebral fractures, although the number of patients studied may be too small to predict this outcome. [23],[24] In 2013, US Preventive Services Task Force concluded that the evidence is insufficient to support the use of vitamin D and calcium supplementation to prevent fractures among community-dwelling men and premenopausal women. [25]

**Enzymes / Hormones**

Estrogens/Progesterone, once used in post menopausal women, has shown to cause a dramatic increase in breast cancer, heart disease, strokes and blood coagulopathies. [26]

Bioidentical Hormones (BHRT), irrespective of the source from where they are obtained, are chemically similar to the non-bioidentical counterparts, and hence are bound to have similar side effects. [27]

**Botanical Products**

In 2004 researcher at the Harvard Medical School tested Indian (Ayurvedic) remedies obtained from shops near Boston’s City Hall. They found that 20% contained potentially harmful levels of Lead, Mercury, and Arsenic. [28]

Between 1978 and 2004, poison control centers in the US received 1.3million reports of adverse reactions to herbal vitamins, minerals, and dietary supplements, of which 175268 required treatment in hospitals, and 139 resulted in deaths. Herbal medicines caused 55 cases of severe of fatal heavy metal poisoning. [29] In 2012, the US FDA estimated that approximately 50000 adverse reactions to supplements occurred every year. [30]

There is no scientific evidence for the effectiveness of Ayurvedic or herbal medicines for the prevention or treatment of any disease.[31] To quote a few examples, common herbal remedies used in India like *Ginkgo biloba* [32] to enhance memory, and Garlic [33] to lower cholesterol, fared no better than placebos in randomized clinical trials.

Chondroitin Sulphate and Glucosamine, which are commonly prescribed in arthritis, also failed to stand the test of Evidence. [34]

**Amino Acids**

Amino acids are theorized to enhance performance in a variety of ways, such as increasing the secretion of anabolic hormones, modifying use of energy during exercise, preventing adverse effects of overtraining, and preventing mental fatigue. The following table highlights research regarding their ergogenic effects-

Use of amino acid supplements is not prohibited by the World Anti-Doping Agency (WADA).

**Proteins**

Protein supplements have been recommended to athletes to enhance nitrogen retention and increase muscle mass, to prevent protein catabolism during prolonged exercise, to promote muscle glycogen resynthesis following exercise, and to prevent sports anemiaby promoting an increased synthesis of hemoglobin, myoglobin, oxidative enzymes, and mitochondria during aerobic training.

The Oxford University Centre for Evidence-Based Medicine examined 431 claims in 104 sport products, mainly Proteins, and found a "worrying" lack of high-quality research, calling for better studies to help inform consumers. [52]

The National Academy of Sciences concluded that in view of the lack of compelling evidence to the contrary, no additional dietary protein is suggested for healthy adults undertaking resistance or endurance exercise. [53]

Growing research is proving that protein supplementation is not needed, except for professional-level athlete in intense training or perhaps gravely ill from starvation or a wasting disease.

**Summary**

Of the 51,000 new supplements on the market, [54] four might be of benefit for otherwise healthy people: Omega-3 fatty acids to prevent heart disease [55] calcium [56] and Vitamin D [57] in post menopausal women to prevent Osteoporosis and Folic Acid during pregnancy to prevent birth defects [58]

People want good health and, because of the hyperbole surrounding the benefits of vitamins, there’s a belief that supra-nutritional doses will improve their quality of life. But in most cases, the perceived improvement doesn’t match what science tells us.

Despite all the wealth of scientific evidence, most Indians don’t know that these megavitamins are not risk free. The practitioners of modern medicine must adhere to the principles of evidence based medicine in prescribing the health supplements and discourage its irrational use in every possible way, and not fall prey to the market-driven unethical practices.

**[ TABLE 1 ]**

|  |  |
| --- | --- |
| Supplement | Increased Absolute Mortality risk over those who did not consume Supplements [4] |
| Multivitamins | 2.4 percent |
| Vitamin B6 | 4.1 percent |
| Folic acid | 5.9 percent |
| Iron | 3.9 percent |
| Magnesium | 3.6 percent |
| Zinc | 3.0 percent |

**[ TABLE 2 ]**

|  |  |  |
| --- | --- | --- |
| **Amino Acid** | **Claimed effects** | **Scientific Evidence** |
| **Tryptophan** | significant improvements in time to exhaustion [35] | did not replicate these findings [36], [37] [38] |
| **Branched Chain Amino Acids** | may delay central nervous system fatigue [39] | no effects on performance [40] [41] [42] [43] |
| **Glutamine** | Boosts immunity [44] | no effect on various tests of the immune response [45] |
| **Aspartates** | Enhanced performance in exercise[37] | Equivocal [37] |
| **Arginine** | Enhances blood flow and endurance | No independent research yet done |
| **Ornithine, Lysine, Arginine** | Growth hormone production | No such effect [46] [47] [48] |
| **Tyrosine** | Enhances aerobic endurance, anaerobic power | No significant effect [49] |
| **Taurine** | Increased cardiac stroke volume [50] | Significant increase in VO2max and cycle ergometer exercise time to exhaustion  Ergogenic effects due to antioxidant activity [51] |

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