

NUTRITIONAL SUPPLEMENTS SYMPOSIUM

THE BALDERDASH AND REALITIES OF HEALTH AND PERFORMANCE CLAIMS FOR SUPPLEMENTS AS EXEMPLIFIED BY CALCIUM CHROMIUM AND VANADIUM

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INTRODUCTION

It is well known that diet is linked to risks leading to chronic diseases that are disabling and terminate life prematurely. Moreover, intakes of dietary components other than essential nutrients (e.g., phytochemicals), or of some essential nutrients (e.g., selenium) beyond those that prevent deficiency pathology have been found to promote health and reduce risks leading to chronic disease. Thus, a new paradigm has evolved in nutrition that recognizes that need for prevention of deficiency pathology as the basis for the formulation of nutritional guidance such as the Recommended Dietary Allowances (RDA), or the new Dietary Reference Intakes (DRI), to be complemented by consideration for the total health effects of a nutrient (1). In other words, the new paradigm considers the beneficial effects of nutrients, including the reduction in the risk of chronic disease at intakes higher than necessary to prevent deficiency, and the determination of upper safe levels of intakes.

Recent recommendations for calcium, including its new DRI, exemplify the new approach for formulating dietary guidance. Numerous studies have shown that an intake of 600 to 800 mg of calcium per day is adequate to maintain calcium balance and to prevent adverse changes in indicators of calcium status or metabolism in humans when they consume diets adequate in all known nutrients important in calcium utilization including vitamins D and K, boron, copper, magnesium, manganese and zinc. Nonetheless, consensus statements promulgated by various work groups and reports by numerous calcium metabolism experts support the recent action of the Food and Nutrition Board to increase the RDA, now the DRI, for calcium from 800 mg/day to 1000 to 1300 mg/day for people aged 9 and over (2) because high intakes of calcium can slow bone loss in post-menopausal women and promote bone formation during adolescence. Many people find it difficult to achieve the new DRI through diet alone, and thus use supplements.

Luxuriant intakes of other nutrients are being recommended because of health benefits; these include folic acid to prevent neural defects and cardiovascular disease, vitamins E and B₁₂ to prevent cardiovascular disease, and selenium to prevent cancer. These recommendations are supported by creditable research findings. Supplements or fortified food is the only way some of these recommended intakes will be reasonably achieved by some people.

The preceding indicates that there are instances where the use of supplements is desirable.

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Unfortunately, the prudent and appropriate use of supplements has been overshadowed by unrealistic health benefits expectations by consumers, and by economic interests. As the result of the nutrition preventing disease concept, health enhancing foods, now called Afunctional foods,@

or supplements, sometimes called Anutraceuticals,@ represent an exploding market in the United States conservatively estimated at \$29 billion a year. Many of the health claims for these supposed health enhancing foods and supplements, however, have not been substantiated by basic research and human trials. This has not prevented a multitude of mountebanks or charlatans from touting all kinds of supplements as magic bullets that cure or prevent many of the feared diseases such as Alzheimer-s disease, cancer, heart disease, osteoporosis, arthritis, and diabetes in the quest for financial gain. In other words, supplements are not inherently good, bad or worthless, it is the manner in which they are presented to the consumer that determines their merit. When one decides to use supplements, there is a need to know that most all of them have some balderdash and realities associated with their marketing. Calcium, chromium picolinate, and vanadium supplements can be used to demonstrate this point.

CALCIUM

Policy makers, researches and clinical professionals have identified osteoporosis as a major public health problem that affects 28 million Americans and costs \$14 billion annually in nursing home and hospital expenditures. Osteoporosis affects 200 million people world wide. In the United States, one out of every two women and one out of eight men over the age of 50 will have an osteoporosis-related fracture in their lifetime. As the population of the United States ages, the cost of osteoporosis is projected to reach \$50 billion by the year 2050 unless some progress is made in its prevention or alleviation. Osteoporosis is a painful, disfiguring, debilitating and life threatening disease. Moreover, the physical deformities and limitations resulting from broken hips and crushed bones in the spine including the stooped posture, dowager-s hump and protruding abdomen can viciously assault self-image and how one feels about themselves. This tremendously affects emotional well-being and often leads to depression.

Based upon media and advertising informational pieces, osteoporosis should not be such a huge problem because all that is needed is to get people to consume more calcium. The usual approach of the advertisements is that Aosteoporosis affects us all, thus for protection against bone loss, calcium intake must be high to the point of taking supplements, fortified foods, or specific foods.@ Because calcium is a major component of bone and some research reports show that high calcium intakes slow bone loss after menopause, this approach seems to be reasonable. However, there is evidence showing that this approach is not adequate and that it is misleading an immensely large number of women into a false sense of security in terms of protecting against osteoporosis.

The Balderdash of Calcium Supplements for Osteoporosis

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International comparisons of the dependence of osteoporosis incidence on dietary calcium intake show that incidence is generally *lower* in countries where calcium intakes are traditionally low, often 500 mg/day or less (3). Countries including the United States that consume the most calcium per capita, and also are the largest consumers of dairy products have the highest incidence of osteoporosis. The high incidence occurs in the United States despite being the country which consumes the greatest amount of calcium supplements. Reports by reputable researchers have shown that calcium supplementation does not prevent post-menopausal spinal bone loss or significantly reduce the incidence of fracture, especially if usual intakes before supplementation exceed 500 mg/day (4-6). Some of the statements by people who have concluded that calcium supplementation is ineffective by itself in preventing osteoporosis include "Calcium is the laetrile of osteoporosis" and "It seems clear that calcium alone, even in massive doses, does not prevent bone loss" (6).

It can be safely stated that osteoporosis is not necessarily a nutritional calcium deficiency disease. On the other hand, osteoporosis is a calcium deficiency in bone. It is surprising that many people have accepted the concept that if bone is deficient in calcium, the way to overcome the problem is to put more calcium in the gut and that will result in more calcium in bone. This concept ignores the fact that before calcium can be made into bone a large number of other essential nutrients, especially micronutrients such as some trace elements and vitamins, are needed to stimulate the formation of osteoblasts, to make proper collagen and proteoglycans on which calcification occurs, and to be involved in calcification initiation and proper bone crystal formation in addition to proper bone resorption. Suboptimal status in any of these nutrients could result in one portion of bone metabolism going awry which would lead to an imbalance between bone breakdown and formation. If a nutrient is essential, it means no other substance can replace its need in the diet. Thus, it should not be expected that a high dietary intake of calcium or calcium supplementation will prevent osteoporosis caused by the lack of some other essential nutrient such as boron, copper or magnesium. Basically, the recommendation to take calcium supplements is a pharmacological not a nutritional recommendation. Supra nutritional intakes of calcium most likely slow bone loss by suppressing the secretion of parathyroid hormone which induces bone resorption. Thus, supra nutritional intakes of calcium can be considered a cheap alternative to other pharmacological approaches used to prevent bone loss such as estrogen therapy, calcitonin injections and diphosphonate drugs.

The Realities of Beneficial Calcium Supplementation

Two studies have effectively shown that more than calcium supplementation is needed to have a major impact on the incidence or severity of osteoporosis. In one study (7), 59 healthy older post-menopausal women were fed a placebo, a trace element supplement, a calcium supplement, or the combined trace element and calcium supplements. Over a two year period, the women on the placebo lost an average of 3.53% of their bone density. When only the trace mineral supplement containing 15 mg of zinc, 5 mg of manganese and 2.5 mg of copper was fed, the average bone density loss was 1.89% while the calcium supplement of 1000 mg/day allowed

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a loss of 1.25%. On the other hand, the combined calcium and trace element supplement not only stopped bone density loss, but actually resulted in an apparent increase of 1.48%. In the other study (8), post-menopausal women who were on hormone replacement therapy were given either no supplement (7 women) or a multivitamin, multimineral supplement containing 500 mg of calcium, 600 mg of magnesium, 2 mg of copper and 10 mg of manganese (19 women). Bone density did not change over 10 months without the supplement, but with the supplement, the average bone density increased from 0.30 g/cm⁵ to 0.337 g/cm⁵.

The preceding discussion should not leave one with the impression that calcium is not important in the osteoporosis story. The two studies described above indicate this. There are several reports that indicate the consumption of less than 500 mg of calcium daily greatly increases the risk of bone loss, and that many post-menopausal women routinely consume less than this (4,5). This implies that inadequate calcium intake is a real nutritional concern because it significantly contributes to the incidence of osteoporosis. Although the consumption of foods luxuriant in calcium is the desired method to meet calcium needs, calcium supplements or fortified foods may be useful for the achievement of desired intakes because of difficulty in consuming those foods. Some people will want to take a calcium supplement for insurance purposes. In these instances the best calcium supplement is one that is part of multinutrient supplement because it also will contain other nutrients required for bone health.

In summary, the balderdash of calcium supplementation is that by itself it will not prevent post-menopausal bone loss. The realities of supplementation is that it may help achieve intakes needed for proper calcium status, and in conjunction with other essential nutrients, assure good bone growth and maintenance.

CHROMIUM PICOLINATE

The touted benefits realized through chromium picolinate supplementation are numerous and often outrageous. For example, one weight loss advertisement stated "Since picotrim (chromium picolinate) is so effective at removing fat and cellulite and has no side effects some people can lose weight too fast. Don't allow yourself to become too thin." Another claim appearing in a supermarket tabloid was that chromium picolinate can increase average life span 25 years, or from 75 to 100 years. Other advertisements and tabloid-type articles claim that chromium picolinate supplementation can build muscle, enhance athletic performance, prevent osteoporosis and ischemic heart disease in addition to being effective in preventing and treating type II diabetes. With such claims it is no wonder that some ten million Americans consume \$150 million worth of chromium supplements a year, which makes it the largest selling mineral supplement after calcium in the United States. However, many of these sales are based on misleading and fraudulent claims.

Chromium Picolinate and Weight Loss

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The astonishing claims for weight loss with chromium picolinate supplementation are quite flabbergasting when one considers the data on which they are based. In one study (9) on which the claims are based, the average fat loss was 4.2 pounds with a 1.4 pound increase in fat free mass over a 72 day period of taking 200 Fg/day of chromium as a picolinate supplement. Stated another way, this is only a loss of 2.8 pounds after 10 weeks of supplementation. Another study (10) used to support weight loss claims was not limited to just chromium supplementation. The program included moderate caloric restriction combined with nutritional support from dietary fiber and L-carnitine. Thus, although a respectable weight loss of 15 pounds was achieved in 8 weeks, the loss could not be attributed to solely to chromium picolinate supplement. In a third study (11), only after adjustments were made for energy expenditure in daily activities was a significant difference in weight loss achieved with a 400 Fg/day chromium picolinate supplement compared to a placebo (-2.8 vs - 1.9 kg in 90 days). In contrast to these studies, another study found that chromium picolinate supplementation resulted in significant weight gain in young obese women (12). To summarize, there are no data from well-controlled studies to support the claim that chromium picolinate is an effective weight loss modality.

Chromium Picolinate as an Ergogenic Aid

The notion that chromium picolinate would have an ergogenic effect is suggested by its apparent nutritional or biochemical actions. Chromium is known to potentiate insulin action. Insulin has an anabolic effect on skeletal muscle and other tissues through the promotion of amino acid uptake and protein synthesis while retarding protein degradation. Thus, when it was reported that 42 off-season college football players undergoing a weight training program exhibited a significantly higher increase in lean body mass, based on skin-fold measurements, when supplemented for six weeks with chromium picolinate and supplied 200 Fg of chromium/day and compared with receiving a placebo (13), the findings seemed reasonable. This report precipitated tremendous interest in chromium picolinate by athletes and body builders looking for a possible substitute for performance enhancing anabolic steroids. As a result, over 100 products containing chromium picolinate alone, or in combination with other nutrients, herbs, and amino acids in the form of tablets, capsules powders and beverages have appeared in the marketplace as muscle and strength enhancers. Unfortunately, as so often happens when some flashy or spectacular finding appears for a substance that could possibly be put in a supplement well designed experiments with sophisticated methods did not confirm or support the initial anabolic findings for chromium picolinate. Several studies (14-16) have shown that 200 Fg chromium/day as a chromium picolinate supplement did not significantly affect body fatness fat free mass, strength and performance in young men in weight training programs. In other words, the data related to chromium supplementation improving lean body mass, strength gain, and athletic performance are mostly negative.

Chromium Picolinate and Lifespan Extension

The basis for the claim that chromium picolinate will extend your lifespan is an experiment

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which showed that after 41 months of being fed a diet supplemented with chromium picolinate, chromium nicotinate or chromium chloride, all rats fed chromium chloride or chromium nicotinate had died, while 80% of the rats fed chromium picolinate were still alive (17). The role of chromium in this experiment is unclear because all three supplements contained this element. Moreover, the life extending findings need confirmation before any claims can be justified for chromium supplementation having such an effect.

Chromium Picolinate and Osteoporosis

The basis for the suggestion that chromium may be effective in preventing osteoporosis is that postmenopausal women taking a chromium supplement exhibited increased plasma dehydroepiandrosterone, a precursor of estrogen which inhibits bone loss, and decreased urinary calcium and hydroxyproline excretion (18), which are indirect rather variable indicators of bone loss. These provocative findings need to be confirmed, and the prevention of bone loss needs to be validated by the use of methods that can directly detect changes or no changes in bone composition with chromium supplementation. Until then, chromium supplementation should be viewed as only one of a number of speculative methods that may help in maintaining healthy bones.

Chromium Picolinate as Treatment for Diabetes

Recent findings indicate that one claim for a beneficial action of chromium supplementation is valid, that is for the treatment of diabetes. In a double-blind randomized study of 180 Beijing, China, residents high blood glucose measures were reduced to near normal by a chromium picolinate supplement providing 1000 Fg chromium/day (19). For example, glycated hemoglobin was reduced from an abnormal 9.4% to a high normal 6.6%. Since about 1970 numerous other reports (20,21) have appeared which indicate that chromium can potentiate the action of low amounts of insulin or improve the efficacy of insulin such that the need for exogenous sources is reduced or eliminated for some type II diabetics. Thus, there is a growing body of evidence suggesting that chromium supplementation might be a viable treatment option for some people with diabetes resulting from inadequate synthesis of insulin or with insulin resistance. However, it needs to be emphasized that only a select group of people can use this as a basis for taking high, or pharmacological, doses of chromium, and this probably is best when done while under the care of a physician.

Chromium as an Essential Nutrient

There is another basis for taking chromium supplements. The evidence for chromium being an essential nutrient is quite substantial, and that an intake of less than 20 Fg/day is generally inadequate to meet its nutritional requirement. Based on dietary surveys, a significant number of Americans consume less than 20 Fg/day. As a result, it is not surprising that many studies have identified individuals who responded in a desirable manner in regards to glucose metabolism and

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to composition and concentrations of blood cholesterol, when given supplements of chromium. It should be pointed out that a larger number of individuals in these studies did not respond to chromium supplementation. This suggests that the chromium supplementation was not a value because of an adequate chromium status.

In summary, most marketing claims for chromium, especially for weight loss and as an anabolic substance, are balderdash. However, chromium in pharmacological amounts, which can be achieved only by supplementation, may be an effective treatment option for diabetes. The finding of some responders in studies involving a relatively small number of subjects indicates that there are a significant number of people that could benefit from an increased chromium intake. One way this could be achieved is through supplementation, but a preferable and more enjoyable method would be through a diet containing high chromium foods such as whole grains, pulses, selected vegetables, liver and perhaps beer.

VANADIUM

In the last 15 years, high doses of vanadium have been shown to have efficacy in some animal models of both type I and II diabetes (22). Vanadium does this by directly acting on tissues normally affected by insulin, that is, it mimics insulin. Because insulin has an anabolic effect on skeletal muscle, the finding that vanadium mimics insulin was quickly extrapolated by supplement marketers as support for the claim that vanadium has anabolic effects, and thus can be used to enhance muscle building, strength and performance. This is the basis for the recent proliferation of powders, beverages, formulas and supplements containing alarming amounts of vanadium.

Vanadium supplements available today are of concern because they may contain toxic amounts of this element. The amounts of vanadium needed in animal studies to mimic insulin were extremely high to the point of being toxic. Poor appetite, poor growth, diarrhea and death have commonly occurred in these studies. In addition vanadium has been shown to induce transformation of different cell lines (23) which indicates that high vanadium intakes may be potentially carcinogenic. Moreover, long term vanadium supplementation has been shown to induce hypertension in rats (24).

The circumstantial evidence suggesting that vanadium is an essential nutrient indicates that a daily dietary intake of 10 Fg will meet any postulated requirement. Most mineral elements consumed in amounts 100 times their nutritional requirement show some toxicity. This suggests that a safe daily intake of vanadium is under 1 mg/day. There are some findings that indicate an intake over 10 mg/day is toxic (25). Many supplements contain greater than 10 mg of vanadium. There is no question that more needs to be known about the consequences of high vanadium intake that result from the use of vanadium supplements available today. Vanadium supplements is an example of where the balderdash associated with their marketing is not only worthless, but most likely harmful to health.

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In summary, the balderdash of vanadium is its marketing as an anabolic agent because the amounts in supplements may have toxic consequences. The reality is that there is no nutritional basis for vanadium supplementation.

CONCLUSION

Calcium, chromium picolinate and vanadium have been used as examples to show that mineral supplementation is a tricky venture. Many supplements are worthless because the body has no need for them. Some supplements may be harmful. Some supplements may have beneficial effects in pharmacological amounts which could adversely affect the need or metabolism of other nutrients. Some supplements may actually help one achieve the objective to live a higher quality, longer life. Because deciding whether the marketing of a supplement is based on balderdash or authentic information is such a difficult task, a recommendation is to consume a diet based on the USDA food pyramid. Eating a healthy diet will assure the intake of all essential and many beneficial substances such as phytochemicals; the likelihood that vitamin and mineral supplements will do the same is not very great. However, for those people who insist that they want an alternative method than a balanced diet to assure the intake of substances that can help them live longer and live better, a one-a-day vitamin and mineral supplement that provides all known essential nutrients in amounts near their RDAs is all that is necessary. This type of supplementation does no harm, may actually help some people, and should not be tough on the pocketbook.

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