Advantages of Vitamin D

Vitamin D has gained greater attention over the past few years based on a growing body of evidence that suggests a greater physiological need of the vitamin may exist for optimal health and function. This information has been compounded by an increasing concern of worldwide deficiency. Due to the fact that vitamin D supports a large number of physiological processes the current pandemic (50% of the population) increases international susceptibility to health problems. Early on, the known benefits of vitamin D were essentially limited to calcium homeostasis and the prevention of bone disease. Today it has become clear that vitamin D is actually an emerging super nutrient, serving a role in disease prevention including cancer and heart disease, inducing cellular differentiation, increasing cognitive function, enhancing muscle morphology and of course reducing the risk of osteoporotic fractures.

Since vitamin D deficiency has been associated with chronic health problems including bowel and colon cancer, osteoarthritis, metabolic and cardiovascular disease there is increasing support from medical professionals to raise the current USDA-DRI value of 400 IU to levels that may better serve positive health. Meta-analysis of 18 studies found a reduced risk of disease with individuals who supplemented vitamin D. In fact, according to a study published in *Nutrition Reviews* (Aug. 2007) colon and breast cancers risk is decreased with supplemental values of 1000-2000 IU's (at a minimum) with higher values of 2000-3500 IU's considered optimal to raise blood levels to the recommended 55 ng/ml. The claims go on to suggest that blood levels of >34 ng/ml reduce colon cancer risk by 50% and a value of >52 ng/ml similarly reduces breast cancer risk. The average American gets about 230 IUs per day and in the winter where less light exposure is common, blood levels are predicted to average between 15-18 ng/ml.

The type of vitamin D is relevant to the body's blood levels. The two main forms of vitamin D are D_2 (ergocalciferol) which is consumed in the diet and formed from the irradiation of ergosterols in plants and vitamin D_3 (cholecalciferol) which is formed in the skin through sunlight (ultraviolet radiation) activation of 7-dehydrocholesterol in the cell membranes. Calcitriol, or 1,25-Dihydroxycholecalciferol, is often referred to pas the bioactive form of vitamin D(3) in the body and is predictive of sufficiency. Vitamin D_3 is the more desirable version identifying the importance of adequate sun exposure, but is also available in the diet through cold water fish including cod liver oil, salmon, mackerel and herring. Dietary fortification of vitamin D in milk, orange juice and even many supplements is commonly in the D_2 form which is less potent. Typically there is about 100 IU of vitamin D in an 8 ounce serving of fortified juice or milk and about 200 IU in a 3 ounce serving of tuna. Individuals who do not consume dairy (milk, cheese and yogurt are fortified) and consume little or no fish run a heightened risk of deficiency. This is particularly a concern for individuals who are lactose intolerant or avoid milk for other purposes.

Once vitamin D is ingested or synthesized in the skin it is transported to the liver and metabolized into its primary circulating form which serves as the marker of vitamin D status. The kidneys are primarily responsible for converting circulating D into the active form that syncs with

receptors in the intestine and bone for physiological functions. Non-calcium regulating tissues can also convert circulating D into the active form that may potentially regulate genes to facilitate cell growth and differentiation and possibly reduce the risk of cellular transformation to malignancy. Due to the presence of vitamin D receptors in most tissues and cells in the body, the active form of vitamin D can serve as a potent regulator of cell growth in normal cells as well as cancer cells.

Not unlike bone, muscle tissue requires vitamin D for optimal function and therefore deficiency leads to weakness. In its active form, vitamin D attaches to receptors in skeletal muscle tissue promoting protein synthesis, muscle cell hypertrophy and improved function. In the aging population, a lack of vitamin D is perceived to contribute to sarcopenia (muscle atrophy) and increase risk of postural sway and falls. Interestingly, when older females were provided either vitamin D-only, calcium-only, or placebo those receiving vitamin D-only experienced a 22% reduction in falls. This may hold relevance as neuromuscular dysfunction is blamed for the largest single cause of injury-related deaths in the elderly and accounts for a significant number of nursing home residents. Of further interest, vitamin D intake has been correlated with a direct improvement in neuromuscular function as well as central processing, cognition, and motor response in the elderly which collectively reduce risk for falls and consequent fractures.

This information has not eluded the sports environment where there has been increasing interest as to the impact vitamin D may have on muscle morphology and function. Literary content is still limited in this area but evidence is accumulating to support vitamin D as a potential ergogenic agent. New studies allude to the functional role vitamin D plays in muscle tissue and identify the mechanistic potential for vitamin D within skeletal muscle and the possible impact vitamin D deficiency may have on reduced performance and increased risk of injury in athletic populations. The evidence suggests that the vitamin D is involved at both the genomic and non-genomic levels as nuclear receptors and cell surface receptors for active D have been identified. The location of these receptors suggests vitamin D is affecting the cell at multiple levels including mRNA. Although further research is needed to identify the exact underlying mechanisms of vitamin D's action on muscle tissue and to determine how these cellular changes translate into improvements in physical performance there are indications that warrant attention to vitamin D intake to ensure optimal neuromuscular performance.

For female athletes there is an even stronger case to ensure adequate vitamin D is routinely consumed. In addition to the possible muscle morphologic factors, females run an increased risk of bone loss, evidenced by a higher number of stress fractures and injuries associated with the female triad. Female athletes and fitness enthusiasts who do not support physical activity with adequate nutritional support and emphasize caloric restriction are at the greatest risk. If vitamin D is in fact involved to a high degree in muscle function and the strength of the muscle tissue acting on the bone is a predictor of bone mineral density, a lack of vitamin D is actually compounding in its effect on potential bone loss.

The elderly population will also have similar concerns. Vitamin D intake is responsible for the calcium–phosphorus product in bone and

when inadequate vitamin D is consumed limitations to this product reduce mineralization. It is estimated that 1 in 2 women and 1 in 12 men over age 50 will experience an osteoporotic fracture and researchers suggest that vitamin D intake may be the best predictor of fracture risk. Clinical evidence suggests that vitamin D sufficiency may reduce osteoporotic fractures by 50-60% in these populations. Due to the reduction of the active form of vitamin D in the elderly, D_3 supplementation is considered necessary. Older adults suffer from reduced circulating active D due to a reduction in calcium absorption and reduced production of vitamin D in the skin and in some cases lower absorption rates in general with aging. One research trial demonstrated improvements in the aforementioned population using 800 IU per day in patients over 65 (to 85) with a reduction in fractures of 33% over a 4 year period. These reduced risks may be additionally related to the known improvements in motor response with adequate vitamin D in the blood.

Supplementation with vitamin D to sufficiency has also gained support by physicians for disease prevention. In studies analyzing risk of autoimmune disease those with inadequate vitamin D ran an increased risk for diabetes, rheumatoid arthritis, lupus, and multiple sclerosis whereas those with sufficient vitamin D in the blood experienced notable risk reduction. In fact it is suggested that adequate vitamin D, up top levels of 2000 IU, have improved insulin sensitivity and beta-cell function leading to a significant reduction of diabetes in evaluated populations including children. Blood vitamin D at levels less than 20 ng/ml were associated with reduced beta cell activity suggesting deficiency adds to risk.

The added vitamin D benefit seems to lend itself to a reduction in cancer and cardiovascular disease risk as well. A 60% decrease in all cancer risk was found among post-menopausal women consuming additional calcium plus 1000 IU of vitamin D compared to placebo. According to data collected from the Health Professional Follow-up Study, adequate vitamin D in the blood was associated with 17% reduction in all-cancer, 29% reduction in all-cancer mortality rates and a greater than 40% reduction in both digestive cancer incidence and mortality. Similar findings supported the need for adequate vitamin D to also reduce the risk of heart disease and related mortality. Low levels of vitamin D are considered an independent risk factor for heart attack, whereas in studied populations, blood levels of vitamin D higher than 30 ng/ml decreased risk of myocardial infarction by more than 50%. Clinical findings suggest that vitamin D deficiency promotes hypertension whereas vitamin D sufficiency enhances endothelial function and serves to be cardioprotective. In fact, the third National Health and Nutrition Examination Survey (NHANES) demonstrated a link between low levels of vitamin D and cardiovascular risk with the probable mechanism of vascular calcification.

Based on this information clinicians are reviewing the role of vitamin D as a mechanism for improved health and reduced risk for illness. Although new DRI-RDA values have not been assigned, many believe the government will increase the recommended daily value to promote vitamin sufficiency. Individuals who do not consume adequate vitamin D from food sources and/or do not get enough sunlight exposure may be at an increased risk for disease and experience physical consequences associated with the deficiency. Nutritionists strongly recommend vitamin D in D_3 form when considering supplementation. Whenever considering

supplementing a nutrient, always consult your physician. This is particularly important for dietary adjustments for children