The Vitamin D Newsletter
March, 2007

Peak Athletic Performance and Vitamin D

"No way doc." I had just finished telling my vitamin D deficient patient about the benefits of vitamin D, telling him he needed to take 4,000 IU per day. I used all the techniques I had learned in 30 years of medical practice to convince someone when proper treatment is needed. However, he knew the U.S. government said young people only needed 200 IU per day, not 4,000. He also knew the official Upper Limit was 2,000 IU a day. "What are you trying to do doc, kill me?"

I told him his 25(OH)-vitamin D blood test was low, only 13 ng/ml. He had read about that too, in a medical textbook, where it said normal levels are between 10 and 40 ng/ml. "I'm fine doc;" adding "Are you in the vitamin business?" I explained I was not; that the government and textbooks used outdated values; that recent studies indicate ideal 25(OH)D levels are about 50 ng/ml; and that recent studies indicated that he needed about 4,000 IU per day to get his level up to 50. "No thanks doc, I'm fine."

So I tried a different tact. I brought him copies of recent press articles. "Look," I said, "look at these." *Science News* called vitamin D the Antibiotic Vitamin. *The Independent* in England says vitamin D explains why people die from influenza in the winter, and not the summer. *U.S. News and World Report* says almost everyone needs more. *Newsweek* says it prevents cancer and helps fight infection. In four different recent reports, *United Press International* says that: it reduces falls in the elderly, many pregnant women are deficient , it reduces stress fractures, and that it helps heals wounds.

He glanced at the articles, showing a little interest in stress fractures. Then he told me what he was really thinking. "Look doc, all this stuff may be important to old guys like you. I'm 22. All I care about are girls and sports. When I get older, maybe I'll think about it. I'm too young to worry about it. I'm in great condition." I couldn't argue. He was in good health and a very good basketball player, playing several hours every day, always on indoor courts.

What could I do to open his eyes? As an African American, his risk of early death from cardiovascular disease or cancer was high, although the risk for blacks doesn't start to dramatically increase until their 40's and 50's. Like all young people, he saw himself as forever young. The U.S. government was no help, relying on a ten-year-old report from the Institute of Medicine that is full of outdated studies and misinformation.

I tired to tell him that the 200 IU per day the U.S. government recommends for 20-year-olds is to prevent bone disease, not to treat low vitamin D levels like his. I pointed out the U.S. government's official current Upper Limit of 2,000 IU/day is the

same for a 300 pound adult as it is for a 25 pound toddler. That is, the government says it's safe for a one-year-old, 25-pound, child to take 2,000 IU per day but it's not safe for a 30-year old, 300-pound, adult to take 2,001 IU a day. I mean, whoever thought up these Upper Limits must have left their thinking caps at home. Nevertheless, nothing worked. My vitamin D deficient patient was not interested in taking any vitamin D.

What are young men interested in? I remembered what he told me: "Sex and sports." Two years ago I researched the medical literature looking for any evidence vitamin D enhanced sexual performance. Absolutely nothing. That would have been nice. Can you imagine the interest?

Then I remembered that several readers had written to ask me if vitamin D could possibly improve their athletic performance? They told me that after taking 2,000 to 5,000 IU per day for several months, they seemed a little faster, a little stronger, maybe had a little better balance and timing. A pianist had written to tell me she even played a better piano, her fingers moved over the keys more effortlessly! Was vitamin D responsible for these subtle changes or was it a placebo effect? That is, did readers just think their athletic performance improved because they knew vitamin D was a steroid hormone precursor (hormone, from the Greek, meaning “to set in motion”)?

The active form of vitamin D is a steroid (actually a seco-steroid) in the same way that testosterone is a steroid and vitamin D is a hormone in the same way that growth hormone is a hormone. Steroid hormones are substances made from cholesterol, which circulate in the body, and work at distant sites by setting in motion genetic protein transcription. That is, both vitamin D and testosterone set in motion your genome, the stuff of life. While testosterone is a sex steroid hormone, vitamin D is a pleomorphic (multiple function) steroid hormone.

All of a sudden, it didn't seem so silly. Certainly steroids can improve athletic performance although they can be quite dangerous. In addition, few people are deficient in growth hormone or testosterone, so athletes who take sex steroids or growth hormone are cheating, or doping. The case with vitamin D is quite different because natural vitamin D levels are about 50 ng/ml and, since almost no one has such levels, extra vitamin D is not doping, it's just good treatment. I decided to exhaustively research the medical literature on vitamin D and athletic performance. It took me over a year.

To my surprise, I discovered that there are five totally independent bodies of research that all converge on an inescapable conclusion: vitamin D will improve athletic performance in vitamin D deficient people (and that includes most people). Even more interesting is who published the most direct literature, and when. Are you old enough to remember when the Germans and Russians won every Olympics in the 60's and 70's? Well, it turns out that the most convincing evidence that vitamin D improves athletic performance was published in old German and Russian medical literature.

With the help of my wife and mother-in-law, both of whom are Russian, and with the help of Marc Sorenson, whose book Solar Power is a must read, I finally was able to look at translations of the old Russian and German literature. When one combines that old literature with the modern, and large, English language literature on vitamin D and neuromuscular performance, the conclusion is inescapable. The readers who wrote me are right.

If you are vitamin D deficient, the medical literature indicates that the right amount of vitamin D will make you faster, stronger, improve your balance and timing, etc. How much it will improve your athletic ability depends on how deficient you are to begin with. How good an athlete you will be depends on your innate ability, training, and dedication.

However, peak athletic performance also depends upon the neuromuscular cells in your body and brain having unfettered access to the steroid hormone, activated vitamin D. How much activated vitamin D is available to your brain, muscle, and nerves depends on much 25-hydroxy-vitamin D is in your blood. In turn, how much 25-hydroxy-vitamin D is in your blood depends on how much vitamin D you put in your mouth or how often you expose your skin to UVB light.

Why would I write about such a frivolous topic like peak athletic performance when cancer patients all across this land are dying vitamin D deficient? Like many vitamin D advocates, I have been disappointed that the medical profession and the public don't seem to care about vitamin D. Maybe people, like my young basketball player, will care if it makes better athletes. So, Hey! You jocks! Listen up! I'm talking speed, balance, choice reaction time, muscle mass, muscle strength, squats, reps, etc. Important stuff. Here's the Vitamin D Council's first ever sports quiz.

1. Vitamin D-producing UVB radiation improves athletic performance and may have been widely practiced by German and Russian Olympic athletes in the 1960's and 70's.

True. I found tantalizing evidence the Russians and especially the Germans were on to this during the 60's and 70's when those two nations took turns placing first and second in the Olympics every year? For example, in 1938, Russian researchers reported that a course of ultraviolet irradiation improved speed in the 100-meter dash in college students compared to matched controls, both groups undergoing daily training. Average 100-meter dash times decreased from 13.51 seconds to 13.28 seconds in the non-irradiated training students, but from 13.63 seconds to 12.62 seconds in the irradiated students undergoing training. Here we see training improved times but training and irradiation improved times much more. Obviously, irradiation or vitamin D would not render the same magnitude of improvements in world-class sprinters, but they might be happy with a few milliseconds.

Gorkin Z, Gorkin MJ, Teslenko NE. [The effect of ultraviolet irradiation upon training for 100m sprint.] The Journal of Physiology of the USSR [Fiziol, z. (RSSR)] 1938; 25: 695-701. (In Russian)

If you want to know what German scientific thinking was, read this summation of the early German literature:

> "It is a well-known fact that physical performance can be increased through ultra-violet irradiation. In 1927, a heated argument arose after the decision by the German Swimmers' Association to use the sunlamp as an artificial aid, constituting an athletic unfairness, doping, so to speak. In 1926, *Rancken* had already reported the improving effect of sunlamp irradiation on muscle work with the hand-dynamo-graph. *Heib* observed an improvement in swimming times after repeated irradiations. In thorough experiments, *Backmund* showed that a substantial increase in muscle activity happens after radiation of larger portions of the body with an artificial sunlamp; that this performance increase is not caused through local – direct or indirect – effects on the musculature, but through a general effect. This general effect, triggered by ultra-violet irradiation, is caused by a systemic effect on the nervous system." (p. 17)

Parade GW, Otto H. Die beeinflussung der leistungsfahigkeit durch Hohensonnenbestrahlung. Zeitschrift fur Klinische Medizin (Z Klin Med),1940;137:17-21 [In German]

In 1945, two Americans measured the cardiovascular fitness and muscular endurance of 11 male Illinois subjects undergoing training in an indoor physical education class, comparing them to 10 matched controls. Both groups underwent similar physical training. Treatment consisted of ultraviolet irradiation, given in the nude, up to two minutes per session, three times per week, for ten weeks in the late fall and winter. After ten weeks, the treatment group had a 19% standard score gain in cardiovascular fitness compare to a 2% improvement in the control students. To regular readers of this newsletter, it should come as no surprise that the un-irradiated control group reported twice as many viral respiratory infections as the treatment group.

Allen R, Cureton T. Effects of Ultraviolet Radiation on Physical Fitness. Arch Phys Med 1945: 10: 641-44.

In 1952, the German sports medicine researcher, Spellerberg, reported on the effects of wholesale irradiation of athletes studying and training at the Sports College of Cologne - including many elite athletes - with a "central sun lamp." The College routinely irradiated athletes in their bathing suits, on both sides of their bodies, for up to ten minutes, twice a week, for 6 weeks, resulting in a "convincing effect" on athletic performance and a "50% reduction" in chronic sports injuries. Results were particularly impressive for swimmers, soccer, handball, hockey, and tennis players, as well as for boxers and most track and field athletes. He reported that irradiation leading to burns, further irradiation of athletes having achieved peak performance, and irradiation within 24 hours of competition, all impaired athletic performance. Their results were so convincing, the "Sports College of Cologne officially notified the National German and International Olympic committee." (p. 570)

Spellerberg AE. [Increase of athletic effectiveness by systematic ultraviolet irradiation.] Strahlentherapie 1952; 88: 567-70. [In German]

In 1952, Ronge exposed 120 German schoolchildren to UV lights installed in classrooms and compared them to 120 un-irradiated control children. Over a two-year period - excluding summer vacations - he tested both groups with a series of six cardiovascular fitness tests using a bike ergometer. Un-irradiated children showed a distinct seasonality in fitness, with the highest values right after summer break and the lowest values in the spring. Treated children showed no seasonal differences in physical performance. Differences in work performance between the irradiated and un-irradiated children were most conspicuous in the spring with 56% difference between the two groups. In a final experiment, he gave 30 children in the control classrooms 6.25 mg (250,000 IU) of vitamin D as a single dose in February and found their performance had “increased considerably,” one month later but did not report the actual numbers. He concluded that vitamin D, either as a supplement or induced via UV irradiation, improved physical performance.

Ronge HE. [Increase of physical effectiveness by systematic ultraviolet irradiation.] Strahlentherapie 1952; 88: 563-6. [In German]

In 1954, another researcher, at the Max-Planck Institute for Industrial Physiology in Dortmund, Germany, administered three different wavelengths of UV light over 8 weeks to university students. He found that ultraviolet light in the vitamin D-producing UVB range was consistently effective in reducing resting pulse, lowering the basal metabolic rate, and increasing athletic performance. UVA had no effect; interestingly, artificial UVC irradiation (the atmosphere normally completely filters out UVC radiation and thus it's not naturally present on earth) also gave some positive results.

Lehmann G. [Significance of certain wave lengths for increased efficacy of ultraviolet irradiation.] Strahlentherapie. 1954 Nov;95(3):447-53. [In German]

In 1956, Hettinger and Seidel irradiated seven subjects in two different experiments: athletic performance on bike-ergometers and forearm muscle strength. They found that UV radiation induced a significant improvement in both muscle strength and athletic performance.

Hettinger T, Seidl E. [Ultraviolet irradiation and trainability of musculature.] Internationale Zeitschrift für angewandte Physiologie, einschliesslich Arbeitsphysiologie 1956; 16: 177-83. [In German]

Another German researcher, at the Institute for Medical Physics and Biophysics at the University of Gottiingen, studied reaction times (the time needed to recognize a light and switch it off) during October and November in a series of controlled experiments on 16 children and an unspecified number of adults. He first controlled for practice effects (getting better by practicing) and then administered nine full-body UV radiation treatments over three weeks to the two treatment groups, using placebo radiation in the two control groups. UV radiation improved choice reaction time by 25% in children and 20% in adults while reaction time worsened in controls.

The improvements in the irradiated groups peaked at the end of the three weeks of UV treatments and reverted to baseline levels three weeks later. In the two control groups, he found distinctly improved reaction times in the sunnier months.

Sigmund R. [Effect of ultraviolet rays on reaction time in man.] Strahlentherapie. 1956; 101: 623-9. [In German]

The next study threw me because it was very well conducted, meticulously designed, and completely negative. In 1963, Berven reported on the effects of ultraviolet irradiation and vitamin D supplementation in a group of 30 Stockholm schoolchildren, aged 10 -11, comparing them to appropriate controls. He found no seasonality of fitness in the control group and no effect from either irradiation or two different vitamin D supplementation protocols (1500 IU of cholecalciferol daily for two months and a single dose of 400,000 IU of ergocalciferol) on performance on a bike ergometer.

Berven H. The physical working capacity of healthy children; seasonal variations and effect of ultraviolet irradiation and vitamin-D supply. Acta paediatrica. Supplementum 1963; 148: 1-22.

However, two things were not right and got me thinking. One, Berven found no seasonality of physical fitness and was the only author who found no such seasonal variations in athletic performance. Second, he found no effect from irradiation, again, the only author. Then I realized he was working with Swedish children in the late 1950's. Supplementation of children with high doses of vitamin D - often as cod liver oil - was routine in Scandinavia in the past, particularly in children. For example, in neighboring Finland, the official recommended daily dose of vitamin D for children - including infants - was 4,000 IU per day until 1964, when authorities reduced it to 2,000 IU/day. (That's right, you read that correctly, 4,000 IU per day for infants, which is too much by the way.)

Hypponen E, *et al*. Intake of vitamin D and risk of type 1 diabetes: a birth-cohort study. Lancet. 2001 Nov 3;358(9292):1500-3.

Hypponen reports that in 1975, Finnish authorities reduced it to 1,000 IU per day, and, in 1992, to 400 IU per day. I emailed Professor Elina Hypponen who confirmed that the Swedish recommendations were similar to the Finnish ones. Therefore, it seems highly unlikely that many of Berven's Swedish children, studied in 1958 and 1959, all from "families with a good standard of living," were vitamin D deficient. Therefore, this study showed that vitamin D will not improve athletic ability in vitamin D replete people. That's very important because it indicates more is not necessarily better. More is only better if you are not taking enough.

In the 1960's, three American researchers conducted experiments with university students. Rosentswieg studied the effects of a single six-minute dose of UV light on each side of the trunk in 23 college women, recording changes in various tests of muscle strength at one and five hours. He found a trend towards significance after five hours in white but not African American students. In 1968, Cheatum found that a six-minute administration of UV light, on each side of the trunk, increased the

speed of 15 college women in the 30-yard dash. In 1969, Rosentswieg found a six-minute dose of UV light, on each side of the trunk, finding improved performance on a bicycle ergometer in college women. However, unlike the Germans and Russians, I could find no evidence that any of these American findings interested any American professionals involved in the care or training of athletes.

Rosentsweig J. The effect of a single suberythemic biodose of ultraviolet radiation upon the strength of college women. J Assoc Phys Ment Rehabil. 1967 Jul-Aug;21(4):131-3.

Cheatum BA. Effects of a single biodose of ultraviolet radiation upon the speed of college women. Res Q. 1968 Oct;39(3):482-5.

Rosentswieg J. The effect of a single suberythemic biodose of ultraviolet radiation upon the endurance of college women. J Sports Med Phys Fitness. 1969 Jun;9(2):104-6.

2. Athletic performance peaks in the summer when vitamin D levels peak, and is at its lowest in the winter when vitamin D levels are at their lowest.

A. True
B. False

True. The studies below show tests of physical performance peak in the summer, when vitamin D levels peak, start to decline in early autumn, as vitamin D levels decline, and athletic performance reaches its lowest point in late winter, when vitamin D levels bottom out. However, it is reasonable to assume that any associations between athletic performance and summer season may be due to "reverse causation." That is, improved athletic performance in the summer might be secondary to increased outdoor physical and recreational activity in the warmer weather with an indoor sedentary lifestyle during the colder months. Maybe people have better athletic ability in the summer simply because they exercise more? If that is true - and using the same logic - athletic performance should not begin to decline until late autumn, because at most temperate latitudes early fall weather is ideal for outdoor physical activities.

However, some of the studies below controlled for seasonal variations in time spent exercising. Besides a consistent positive association of summer season with improved athletic performance, the below studies found an abrupt - and unexplained - reduction in athletic performance beginning in the early fall - when vitamin D levels decline - but when the weather is ideal for outdoor activities.

For example, in 1956, German researchers found a distinct seasonal variation in the trainability of musculature, studying wrist flexor strength in 21 German subjects undergoing daily training. They found highly significant seasonal differences with peak performance during the later part of the summer, an unexplained sharp autumn decline beginning in October, and nadirs in the winter.

Hettinger T, Muller EA. Seasonal course of trainability of musculature. Int Z Angew Physiol. 1956;16(2):90-4.

A study of Polish pilots and crew found physical fitness and tolerance to hypoxia were highest in the late summer with an unexplained sharp decline starting in September. The authors hypothesized that seasonal variations in an unidentified hormone best explained their results.

Kwarecki K, Golec L, Klossowski M, Zuzewicz K. Circannual rhythms of physical fitness and tolerance of hypoxic hypoxia. Acta Physiol Pol. 1981 Nov-Dec;32(6):629-36.

Cumulative work ability among 1,835 mainly sedentary Norwegian men during bicycle exercise tests showed an August peak, a sharp decline starting in the autumn, and a wintertime nadir. There were no seasonal changes in body weights, as might be expected if more caloric-demanding recreational activity during the sunnier months explained their results.

Erikssen J, Rodahl K. Seasonal variation in work performance and heart rate response to exercise. A study of 1,835 middle-aged men. Eur J Appl Physiol Occup Physiol. 1979 Oct;42(2):133-40.

Koch and Raschka controlled for seasonal variations in the time spent exercising by instituting a controlled yearlong training regimen, beginning in December. The training regimen consisted of at least 20 push-ups per day and 2 or 3 long-distances races per week for the entire year. They found the both the number of push-ups and muscle strength peaked in late summer followed by a rapid decline in the fall, and a nadir in the winter, despite continued training. They concluded that seasonal variations in an unidentified hormone best explained their results.

Koch H, Raschka C. Circannual period of physical performance analysed by means of standard cosinor analysis: a case report. Rom J Physiol. 2000 Jan-Dec;37(1-4):51-8.

3. Vitamin D has direct muscle-building (anabolic) effects.

A. True
B. False

True, but only in vitamin D deficient subjects. Both animal and human studies have found that vitamin D directly affects muscle. That is, vitamin D increases muscle mass. For example, Birge and Haddad found that vitamin D caused new protein synthesis in rat muscle.

Birge SJ, Haddad JG. 25-hydroxycholecalciferol stimulation of muscle metabolism. J Clin Invest. 1975 Nov;56(5):1100-7.

What about humans? In 1981, Young performed muscle biopsies on 12 severely vitamin D deficient patients before and after vitamin D treatment. They found type-II (fast-twitch) muscle fibers were small before treatment and significantly enlarged after treatment. Sorensen performed muscle biopsies on eleven older patients with osteoporosis before and after treatment with vitamin D. The percentage and area of fast twitch fibers increased significantly after treatment, despite the lack of any physical training.

Young A, Edwards R, Jones D, Brenton D. Quadriceps muscle strength and fibre size during treatment of osteomalacia. In: Stokes IAF (ed) Mechanical factors and the skeleton. 1981. pp 137-145.

Sorensen OH, Lund B, Saltin B, Lund B, Andersen RB, Hjorth L, Melsen F, Mosekilde L. Myopathy in bone loss of ageing: improvement by treatment with 1 alpha-hydroxycholecalciferol and calcium. Clin Sci (Lond). 1979 Feb;56(2):157-61.

Sato reported that two years of treatment with 1,000 IU of vitamin D per day significantly increased muscle strength, doubled the mean diameter, and tripled the percentage of fast-twitch muscle fibers, in the functional limbs of 48 severely vitamin D deficient elderly stroke patients. The placebo control group suffered declines in muscle strength, and in the size and percentage of fast-twitch muscle fibers.

Sato Y, Iwamoto J, Kanoko T, Satoh K. Low-Dose Vitamin D Prevents Muscular Atrophy and Reduces Falls and Hip Fractures in Women after Stroke: A Randomized Controlled Trial. Cerebrovasc Dis. 2005 Jul 27;20(3):187-192 [Epub ahead of print]

These studies clearly show that vitamin D when administered to vitamin D deficient people stimulates the growth and number of those muscle fibers critical to athletic ability, type-2, or "fast twitch," muscle fibers.

4. Many studies have found direct associations between physical performance and vitamin D levels. That is, the higher your vitamin D level, the better your athletic performance.

A. True
B. False

True. I found 13 positive studies of associations between vitamin D levels and various parameters of neuromuscular performance. However, they were all in old people. Of course, old people can be athletes too. Furthermore, age differences in physiology and pharmacology are quantitative, not qualitative. That is, what is true in old people will be true in young people, although the magnitude might be different. Higher vitamin D levels are associated with a wide variety of athletic performance but appear to have the strongest associations with balance, timing, and timed tests of physical performance.

The three largest studies had more than 7,000 elderly subjects. All found evidence of a vitamin D threshold of between 30 to 50 ng/ml, above which further improvements in athletic performance were not seen. Wicherts and her colleagues found a linear correlation between vitamin D and neuromuscular performance; scores were 78% better for those with vitamin D levels greater than 30 ng/ml compared to those with levels less than10 ng/ml.

Bischoff-Ferrari HA, Dietrich T, Orav EJ, Hu FB, Zhang Y, Karlson EW, Dawson-Hughes B. Higher 25-hydroxyvitamin D concentrations are associated with better lower-extremity function in both active and inactive persons aged > or =60 y. Am J Clin Nutr. 2004 Sep;80(3):752-8.

Gerdhem P, Ringsberg KA, Obrant KJ, Akesson K. Association between 25-hydroxy vitamin D levels, physical activity, muscle strength and fractures in the prospective population-based OPRA Study of Elderly Women. Osteoporos Int. 2005 Nov;16(11):1425-31.

Wicherts IS, *et al.* Vitamin D status predicts physical performance and its decline in older persons. J Clin Endocrinol Metab. 2007 Mar 6; [Epub ahead of print]

Professor Heike Bischoff-Ferrari, now in Switzerland, did the largest study. She and her colleagues found a strong positive correlation and suggestion of a U-shaped curve with athletic performance on one test peaking with vitamin D levels of 50 ng/ml but deteriorating at higher levels. It is interesting to speculate that levels around 50 ng/ml may be optimal for athletic performance as such levels are common in humans living in a “natural” state of sun-exposure, such as lifeguards or tropical farmers.

Bischoff HA, Stahelin HB, Urscheler N, Ehrsam R, Vonthein R, Perrig-Chiello P, Tyndall A, Theiler R. Muscle strength in the elderly: its relation to vitamin D metabolites. Arch Phys Med Rehabil. 1999 Jan;80(1):54-8.

Interestingly, all three studies that looked for an association between mental abilities and vitamin D levels found one. A fourth study, unrelated to athletic function, also found an association. The obvious explanation for these findings is that cognitively impaired patients do not go outdoors as often as higher functioning patients and thus have lower vitamin D levels. However, Dhesi found the association after excluding all but mildly demented patients, making such an explanation more difficult. Flicker and - more recently - Przybelski and Binkley, found the association after controlling for outdoor activities, raising the possibility that the association of vitamin D levels with cognitive abilities is causal. Both the vitamin D receptor and the enzyme necessary to activate vitamin D are present in a wide-variety of human brain tissue. If vitamin D deficiency impairs cognitive abilities, it is likely that such deficiencies will also impair the brain's ability to process the complex circuits needed for peak athletic performance.

Dhesi JK, Bearne LM, Moniz C, Hurley MV, Jackson SH, Swift CG, Allain TJ. Neuromuscular and psychomotor function in elderly subjects who fall and the relationship with vitamin D status. J Bone Miner Res. 2002 May;17(5):891-7.

Kenny AM, Biskup B, Robbins B, Marcella G, Burleson JA. Effects of vitamin D supplementation on strength, physical function, and health perception in older, community-dwelling men. J Am Geriatr Soc. 2003 Dec;51(12):1762-7.

Flicker L, Mead K, MacInnis RJ, Nowson C, Scherer S, Stein MS, Thomasx J, Hopper JL, Wark JD. Serum vitamin D and falls in older women in residential care in Australia. J Am Geriatr Soc. 2003 Nov;51(11):1533-8.

Przybelski RJ, Binkley NC. Is vitamin D important for preserving cognition? A positive correlation of serum 25-hydroxyvitamin D concentration with cognitive function. Arch Biochem Biophys. 2007 Jan 8;

There can be no doubt that higher vitamin D levels are associated with improved athletic performance in the elderly. From what we know of physiology and

pharmacology, the same associations should hold true in young people, including young athletes.

5. Numerous studies have found that vitamin D improves physical performance.

A. True
B. False.

True, but, again, most all the studies are in old persons, not young ones, and none of the studies are in world-class athletes. However, there is no medical reason why vitamin D would improve the physical performance of vitamin D deficient old people but not vitamin D deficient young ones. Eleven studies found vitamin D improved physical performance, mainly on measures of balance and reaction time. The one study of younger subjects showed dramatic physical performance effects in 55 severely vitamin D deficient women.

Sorensen OH, Lund B, Saltin B, Lund B, Andersen RB, Hjorth L, Melsen F, Mosekilde L. Myopathy in bone loss of ageing: improvement by treatment with 1 alpha-hydroxycholecalciferol and calcium. Clin Sci (Lond). 1979 Feb;56(2):157-61.

Gloth FM 3rd, Smith CE, Hollis BW, Tobin JD. Functional improvement with vitamin D replenishment in a cohort of frail, vitamin D-deficient older people. J Am Geriatr Soc. 1995 Nov;43(11):1269-71.

Glerup H, Mikkelsen K, Poulsen L, Hass E, Overbeck S, Andersen H, Charles P, Eriksen EF. Hypovitaminosis D myopathy without biochemical signs of osteomalacic bone involvement. Calcif Tissue Int. 2000 Jun;66(6):419-24.

Prabhala A, Garg R, Dandona P. Severe myopathy associated with vitamin D deficiency in western New York. Arch Intern Med. 2000 Apr 24;160(8):1199-203.

Verhaar HJ, Samson MM, Jansen PA, de Vreede PL, Manten JW, Duursma SA. Muscle strength, functional mobility and vitamin D in older women. Aging (Milano). 2000 Dec;12(6):455-60.

Pfeifer M, Begerow B, Minne HW, Abrams C, Nachtigall D, Hansen C. Effects of a short-term vitamin D and calcium supplementation on body sway and secondary hyperparathyroidism in elderly women. J Bone Miner Res. 2000 Jun;15(6):1113-8.

Bischoff HA, Stahelin HB, Dick W, Akos R, Knecht M, Salis C, Nebiker M, Theiler R, Pfeifer M, Begerow B, Lew RA, Conzelmann M. Effects of vitamin D and calcium supplementation on falls: a randomized controlled trial. J Bone Miner Res. 2003 Feb;18(2):343-51.

Dhesi JK, Jackson SH, Bearne LM, Moniz C, Hurley MV, Swift CG, Allain TJ. Vitamin D supplementation improves neuromuscular function in older people who fall. Age Ageing. 2004 Nov;33(6):589-95.

Sato Y, Iwamoto J, Kanoko T, Satoh K. Low-Dose Vitamin D Prevents Muscular Atrophy and Reduces Falls and Hip Fractures in Women after Stroke: A Randomized Controlled Trial. Cerebrovasc Dis. 2005 Jul 27;20(3):187-192 [Epub ahead of print]

Summary

Five converging - but totally separate - lines of scientific evidence leave little doubt that vitamin D improves athletic performance. (Actually left out a sixth line of evidence, something a little more complicated, studies of muscle strength and vitamin D receptor polymorphisms; the two studies I could find were both positive.) Anyway, the scientific evidence that UVB radiation, either from the sun or from sunbeds, will improve athletic performance is overwhelming and the mechanism is almost certainly vitamin D production. Peak athletic performance will probably occur with 25(OH)D levels of about 50 ng/ml, whether from sun, sunbeds, or supplements.

All that is missing is a big-time professional or college team identifying and then treating their elite athletes who are vitamin D deficient. Can you imagine what such performance-enhancing effects would do for basketball players, most of who are African American and who practice and play indoors all winter? Or gymnasts? Or weight lifters? Can you imagine what it might do for those chronic neuromuscular injuries so common in sports medicine?

However, a word of caution. The above studies suggest that taking too much vitamin D (more than 5,000 IU per day) may actually worsen athletic performance. Take the right amount, not all you can swallow. Take enough to keep your 25-hydroxy-vitamin D levels around 50 ng/ml, year round. Easier yet, regularly use the sun in the summer and sunbeds in the winter - with care not to burn. Once a week should be about right.

When you think about it, none of this should surprise anyone. Every body-builder knows that steroid hormones can improve athletic performance, certainly increase muscle mass. Barry Bonds knows they increase timing and power. Activated vitamin D is as potent a steroid hormone as exists in the human body. However, unlike other steroids, levels of activated vitamin D in muscle and nerve tissue are primarily regulated by sun exposure. That's right, the rate-limiting step for the cellular function (autocrine) of activated vitamin D is under your control. It depends on how much you put in your both or go into the sun. It's ironic that many athletes now avoid the sun, organized baseball is even promoting sun avoidance and sunblocks. The ancient Greeks knew better; they had there elite athletes train on the beach and in the nude.

The medical literature indicates vitamin D levels of about 50 ng/ml are associated with peak athletic performance. Of course, recent studies show such levels are ideal for preventing cancer, diabetes, hypertension, influenza, multiple sclerosis, major depression, cognitive decline, etc. But who cares about all that disease stuff old people get, we're talking about something really important: speed, balance, reaction time, muscle mass, muscle strength, squats, reps, etc. And guess who's now taking 4,000 IU/day? Yes he is, after six months his 25-hydroxy-vitamin D level is now 54 ng/ml, and he tells me his timing is better, he can jump a little higher, run a little faster, and the ball feels "sweeter," whatever that means.

John Cannell, MD

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