about the **AUTHOR**

Rikki Keen is a faculty member at the University of Alaska-Anchorage and owns a private practice, Fuel & Fluids for Performance, LLC. She provides nutrition services for Coach Tom Shaw's NFL training facility, located at ESPN's Wide World of Sports. Rikki consults with individual athletes (recreational, high school, collegiate, Olympic, and professional) and is a scientific advisor for FRS Healthy Energy. Rikki also contributes to www.performancewebinars.com on vitamin D.

The Importance of Vitamin D in Human Performance

Rikki Keen, MS, RD, CSSD, CSCS

Vitamin D is a "sleeper nutrient" when it comes to optimal health and peak performance. Not many vitamins can claim more health functions in the human body than vitamin D. In fact, vitamin D is not a true vitamin but a steroid hormone. Recently, much attention has been placed on studying inadequate levels and gaining new knowledge on vitamin D receptors (on and off switches) found in almost every cell of the human body. Vitamin D can "switch on" cells to help control the immune system, muscle function, inflammatory responses and mental state. Optimal functioning in these areas supports health and well-being.

Vitamin D is unique since our bodies can produce it when the skin is exposed to sunlight. The sun provides approximately 90% of our vitamin D needs. The government recommends we obtain 200 – 600 IUs from diet, depending on age (Table 1) (9). A young athlete drinking two cups of milk can meet the minimum dietary needs for vitamin D (Table 2). Unfortunately, most athletes are not meeting their needs from diet or sunlight (4, 6, 7).

Recent evidence based on blood levels suggests it is extremely difficult to get enough vitamin D from food sources to match optimal levels (Table 3). Other risk factors that hinder us from optimal levels include dark skin color, lifestyle, type of sport, body fat, limited sun exposure and sunscreen use.

Numerous studies have found low vitamin D levels are related to an increased risk of stress fractures, colds/influenza, musculoskeletal pain, depressed mood, inflammation, inadequate immune system and inferior muscle power/strength (1, 2, 3, 9, 10, 11, 12). Evidence suggests increases in colds or influenza maybe due to seasonal vitamin D levels (2). As the sun's rays get weaker and athletes get less sun exposure during the winter, vitamin D levels get lower (Figure 1).

Low levels of vitamin D are common among many athletes (Table 4). No matter if you are an indoor athlete, outdoor athlete, live in Florida or Alaska, do not just assume you are fine (6, 7, 11, 15). Symptoms of vitamin D deficiency are silent or easily overlooked, such as muscle and joint pain or fatigue. The only way to truly know is to get tested. Contact your health care provider or talk to a sports dietitian. A 25-Hydroxyvitamin D (25 (OH) D) is a simple blood test that will tell you your stores of vitamin D.

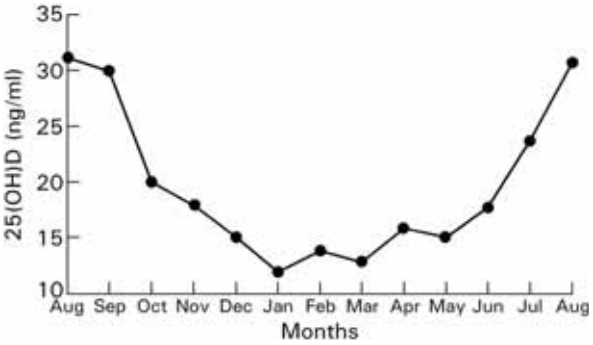

Figure 1. Seasonal Vitamin D Levels (2)

Supplement dose will be determined by the athlete's blood level. It is common and safe to start with 1,000 – 2,000 IU/day and adjust according to lab results. Remember, more is not better; the goal is to replace what is missing. ■

References

1. Aloia, JF, and Li-Ng, M. Epidemic influenza and vitamin *D. Epidemiol Infect*, 135: 1095 – 1096. 2007.

2. Cannell, JJ, Vieth, R, Umhau, JC, Holick, MF, Grant, WB, Madronich, S, Garland, CF, and Giovannucci, E. Epidemic influenza and vitamin D. *Epidemiol Infect*. 134(6): 1129 – 1140. 2006.

3. Cox, AJ, Gleeson, M, Pyne, DB, Callister, R, Hopkins, WG, and Fricker, PA. Clinical and laboratory evaluation of upper respiratory symptoms in elite athletes. *Clin J Sport Med*. 18(5): 438 – 45. 2008.

4. Finland: minor effects. *Br J Nutr*. 100(2): 418 – 23. 2008.

5. Gloth F, Alam, W, and Hollis, B. Vitamin D vs. broad spectrum phototherapy in the treatment of seasonal affective disorder. *J Nutr Health Aging*. 3(1): 5 – 7. 1999.

6. Halliday, T, Peterson, N, Thomas, J, Kleppinger, K, Hollis, B, and Larson-Meyer, D. Vitamin D status relative to diet, lifestyle, injury and illness in college athletes. *Med Sci Sports Exerc*. [Epub ahead of print] 2010.

7. Heaney, S, O'Connor, H, Gifford, J, and Naughton, G. Comparison of strategies for assessing nutritional adequacy in elite female athletes' dietary intake. *Int J Sport Nutr Exerc Metab*. 20(3): 245 – 56. 2010.

8. Holick, MF. Vitamin D deficiency. *N Engl J Med*. 357: 266 – 281. 2007.

9. Institute of Medicine, Food and Nutrition Board. Dietary Reference Intakes: Calcium, Phosphorus, Magnesium, Vitamin D, and Fluoride. Washington, DC: National Academy Press, 1997. Retrieved October13, 2010 from http://ods.od.nih.gov/factsheets/vitamind/

10. Lovell, G. Vitamin D status of females in an elite gymnastics program. *Clin J Sport Med*. 18(2): 159 – 61. 2008.

11. Lehtonen-Veromaa, M, Möttönen, T, Leino, A, Heinonen, OJ, Rautava, E, and Viikari, J. Prospective study on food fortification with vitamin D among adolescent females in Lansdowne, ATG, and Provost, SC. Vitamin D3 enhances mood in healthy subjects during winter. *Psychopharmacology*. 135: 319 – 23. 1998.

12. Larson-Meyer, DE and Willis, KS. Vitamin D and athletes. *Curr Sports Med Rep*. 9(4): 220 – 226. 2010.

13. Plotnikoff, GA, and Quigley, JM. Prevalence of severe hypovitaminosis D in patients with persistent, nonspecific musculoskeletal pain. *Mayo Clin Proc*. 78: 1463 – 1470. 2003

14. Wang, TT, Nestel, FP, et al. 25-Dihydroxyvitamin D3 is a direct inducer of antimicrobial peptide gene expression. *Journal of Immunology*. 173: 2909 – 2912. 2004.

15. Ward, KA, Geeta, DAS, Berry, JL, Roberts, SA, et al. Vitamin D status and muscle function in post-menarchal adolescent girls. *J Clin Endocrinol Metab*. 94(2): 559 – 563. 2009.

Table 1. Vitamin D: Adequate Intake and Tolerable Upper Limit (9)

Age	Adequate Intake/day
Birth – 50	200 IU
51 – 70	400 IU
>70	600 IU
Age	**Tolerable/day**
Birth – 12 months	1,000 IU
> 1	2,000 IU

Table 2. Natural and Fortified Food sources (8,9)

Summer Sunshine ~10,000 IU/20 minutes (arms & legs exposed, light skin tone)	Wild Salmon 800 IU/3.0oz
Sundried Mushrooms 400 IU/3.0oz	Farmed Salmon 200 IU/3.0oz
Milk 100 IU/8oz	Egg Yolk 25 IU

Table 3: Vitamin D: 25-Hydroxyvitamin D lab ranges (1, 2, 3, 8, 9, 12, 14)
*(*may vary, speak to your health care provider for your optimal level)*

Vitamin D Intake	Effects
< 20 ng/ml	Deficient
< 30 ng/ml	Insufficient or Sub-Optimal
30 – 100 ng/ml	Sufficient
~40 – 70 ng/ml*	Optimal for health
> 100 ng/ml	Excessive
> 150 – 200 ng/ml	Possibly Toxic

Table 4: Athlete's vitamin D levels (6, 7, 11, 15)

Sport (location)	25 (OH) D level (ng/mL)
NFL (Pennsylvania)	26
NCAA Football (Florida)	22
NCAA Football (Louisiana)	24
Triathlete (Alaska)	15
Olympic 400m sprinter (Florida)	12