

CAN VITAMIN SUPPLEMENTS IMPROVE SPORT PERFORMANCE?

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KEY POINTS

- n Vitamin deficiencies among various groups of athletes are uncommon, but there are some individual athletes within groups who are vitamin deficient. The most common deficiencies are for the B-complex vitamins (especially B-6 and folate), and for the antioxidant vitamins C, E, and beta-carotene.
- n Athletes most likely to suffer vitamin deficiencies include wrestlers, dancers, gymnasts, and others who restrict their food intake to maintain a low body weight, athletes who have too little time to select and/or eat well-balanced diets, athletes whose diets are too rich in fast food items, and athletes who eat few fruits and vegetables.
- n Vitamin overload in athletes is unlikely unless they are consuming large doses of vitamin supplements and/or large amounts of vitamin-fortified foods.
- n Athletes who wish to be on the “safe side” of avoiding vitamin deficiencies may wish to take a multi-vitamin/multi-mineral supplement each day or every other day. The supplement should not exceed the Recommended Dietary Allowance or Adequate Intake for the vitamin(s).
- n Vitamin supplements can improve sport performance only in athletes who are vitamin deficient. Athletes who have normal stores of vitamins will not benefit from consuming vitamin supplements.
- n Vitamins obtained from natural foods are preferred over vitamin supplements because the natural foods contain important nutrients that can be deficient if athletes rely on supplements.

INTRODUCTION

Athletes—and lots of non-athletes—gulp vitamin pills in tremendous quantities, but most experts tell us that only a small number of athletes will notice any benefit of vitamin supplements on their health or sport performance. Is it O.K. to take vitamin supplements as an insurance policy, in case your diet does not supply sufficient vitamins? Can bad things happen if you take too many vitamins? Are synthetic vitamin pills just as good as vitamins from natural foods?

We posed these and other questions to experts who have outstanding backgrounds in the field of sports nutrition. Dan Benardot is co-director of the Laboratory for Elite Athlete Performance at Georgia State University. He was national team nutritionist for USAGymnastics from 1991-1997 and has authored *Nutrition for Serious Athletes* (Human Kinetics) plus numerous articles in sports nutrition. Priscilla Clarkson, Past President of the American College of Sports Medicine, has written extensively on vitamins in sport and has studied sports nutrition for many years, especially in dancers. Ellen Coleman is the author of two books (Bull Publishing): *Ultimate Sports Nutrition* (2000) and *Eating for Endurance* (1997). She is also the nutrition columnist for *Sports Medicine Digest* and lectures extensively on the dietary needs of athletes and active people. Ms. Coleman has completed numerous marathons and 200-mile bicycle races and is a two-time finisher of the Hawaii Ironman triathlon. Melinda Manore is an expert on the nutritional requirements of active women, nutrition assessment, and the role that nutrition and exercise play in health, energy balance, obesity, and disordered eating. She is Chair of the Research Group of the American Dietetic Association and is a Fellow of the American College of Sports Medicine (ACSM). Prof. Manore writes the nutrition column for the ACSM's *Health and Fitness Journal*. She also co-authored *Sports Nutrition for Health and Performance* (Human Kinetics), and she has served as a nutrition consultant for the Arizona State University intercollegiate teams and for individual professional athletes.

When consuming the “typical” North American diet, which vitamins, if any, are most likely to be consumed in insufficient amounts? Which vitamins are most likely to be consumed in great excess of need in the typical diet?

Benardot: It is generally understood that serious vitamin deficiencies occur in a relatively small proportion of the population. When deficiencies do occur, they happen most often when there is an abnormally high requirement for a specific vitamin (or vitamins) because of fast growth, smoking, pregnancy, disease, alcohol consumption, or other factors. An inadequate consumption of fresh fruits and vegetables may be the most common vitamin-related dietary problem in North America, resulting in potential deficiencies of folate, carotene (pro-vitamin A), and

vitamin C. There is increasingly powerful evidence that inadequate intake of folic acid raises the risks of heart disease and defective development of the fetal brain and that increased consumption of folic acid lowers the risks of both conditions. In addition, physical activity increases the requirement for riboflavin, vitamin B-6, and vitamin C. Moreover, athletes may derive antioxidant-related health benefits from increased consumption of vitamin E.

Combining several risk factors creates the greatest potential for vitamin deficiencies. For instance, adolescent females have a high requirement for all nutrients because of the developmental changes that occur during this life stage, but they frequently have eating behaviors that put them at high risk of vitamin deficiency. Therefore, an adolescent female who exercises frequently may have an exceptionally high risk of vitamin deficiency. The general rule is this: If athletes are not consuming sufficient energy (calories) to meet their combined developmental, maintenance, and activity needs, then they are probably at risk for multiple vitamin deficiencies. The most likely deficiencies are of the B-vitamins, especially folate, but vitamin C and beta-carotene deficiencies are also possible in athletes who consume too few fresh fruits and vegetables.

Clarkson: Because of the many fortified foods on the market, an athlete who may be trying to increase energy intake to match the large energy expenditure during training could inadvertently be ingesting some vitamins in excess. For example, many cereals are fortified with vitamins, and if a fortified cereal were used in excess, say as a frequent snack, this could potentially provide an excess of these vitamins. The widespread use of supplements is a relatively new phenomenon, but as the popularity of dietary supplements and fortified foods continues to grow, adverse effects of over-consumption of vitamins is likely to become more common.

Manore: I agree that the typical American diet, especially for individuals such as wrestlers and gymnasts who are restricting energy intake, may be low in antioxidants and some of the B-complex vitamins (especially folate and B-6). The intakes of these nutrients are more apt to be low in athletes who make poor dietary choices, e.g., those who eat diets with lots of highly processed foods and those who limit their consumption of fortified foods. Vitamins are not likely to be in excess unless an athlete consumes vitamin supplements and fortified foods in excess and/or follows strange dietary habits.

What types of “atypical” diets might lead to vitamin insufficiency or excess, especially in athletes?

Clarkson: One example of an atypical diet used by some athletes is a high-protein diet low in vegetables and fruits, which are the major sources of the antioxidant vitamins C, E, and beta-carotene. Ingestion of sufficient amounts of antioxidants is important for counteracting the stress of exercise. This stress results in a production of free radicals, which are reactive chemicals that can harm membranes of the muscle cells if left unchecked. Vitamins C, E, and beta-carotene are part of the muscle’s elaborate antioxidant defense system to inactivate free radicals. A high-protein diet could be low in vegetables and fruit and, therefore, low in antioxidants. However, any diet where vegetables and fruit are missing or consumed in low amounts could be a problem. Although athletes need sufficient dietary antioxidants, too great an intake of vitamins C, E, and beta-carotene via excessive use of antioxidant

supplements can also lead to problems. Balance is the key, and consumption of fruits and vegetables is the best way to achieve that balance.

Coleman: I concur with Dr. Manore that athletes who limit their calorie intake are at risk for vitamin deficiencies. These athletes usually compete in sports that emphasize leanness for performance (distance runners, wrestlers, lightweight crew) or for appearance (gymnasts, dancers, figure skaters, divers). Also at risk are athletes pressed for time who frequently eat at fast-food restaurants and/or consume quick, portable, non-perishable snacks (e.g. chips, soda) that are not vitamin rich. For these athletes, it is almost impossible to get the recommended amounts of vitamins from food, so a multi-vitamin/mineral supplement containing no more than the recommended amounts for any one micronutrient could be used each day.

Benardot: Any ‘diet’ that reduces food choices increases the risk of vitamin deficiency or vitamin excess. These diets, which often result in the monotonous intakes of a small group of foods, do two things: 1) They reduce exposure to a wide variety of nutrients (including vitamins), thereby increasing the risk of selected vitamin deficiencies, and 2) They increase exposure to the limited nutrients (including vitamins) associated with the consumed foods, thereby also increasing the risk of selected vitamin toxicities. Many athletes place themselves on monotonous intakes that eliminate whole groups of foods as an ill-founded strategy for lowering caloric intakes to reduce weight or body fat. Diets that limit food choices breach a well-established recommendation in nutrition, which is to “...eat a wide variety of foods...” This makes sense on many levels, not the least of which is that it is the only way to assure exposure to the widest possible spectrum of vitamins, without consuming too much of any single vitamin.

Are there some athletes whose health might be improved if they were to take in more vitamins than they do in their usual diets? If so, what are some examples of such athletes and their diets?

Manore: The athletes most likely to have insufficient vitamin intake are those with low calorie intakes or whose diets consist of highly processed convenience foods that are high in fat and/or sugar. If athletes are limiting food intake to maintain a lean build or a low body weight, they should supplement their diets with vitamins and minerals. The specific supplements will depend on their total energy intakes, the foods they typically eat, and their sports.

Are there examples of athletes who suffered obvious adverse effects of vitamin overload, or is it O.K. to take a daily multi-vitamin capsule as an insurance policy against getting too few vitamins in the normal diet?

Coleman: A supplement that contains high amounts of a single micronutrient is more likely to cause adverse effects than a general multi-vitamin/mineral supplement. I recall a case in which a runner took a large dose of niacin prior to a 10 km race. He experienced severe flushing and itching and ran badly as a result. It is unlikely that taking a multi-vitamin/mineral supplement will harm an athlete, provided that the supplement does not exceed the Recommended Dietary Allowance (RDA) or Adequate Intake (AI) for nutrients.

Manore: I concur that using a daily multi-vitamin capsule that provides close to the RDA or AI for micronutrients poses no problem for most individuals. Vitamin overload is most likely to occur in those who eat a number of highly fortified foods throughout the day and also supplement with many times the recommended amounts of vitamins.

Benardot: I have not witnessed any toxic reactions to vitamin excess in athletes, but such effects usually take a long time to become apparent. I believe that consumption of one supplement providing 100% of the Recommended Dietary Allowance taken every other day or every third day makes sense in that it would provide sufficient nutrient value to act as a security blanket, yet avoid the potential for over consumption that could lead to toxicity. Importantly, taking a supplement several times each week, as opposed to every day, makes it less likely that the supplement would be confused as a satisfactory alternative to normal eating.

Can vitamin supplements improve the performance of any sport?

Benardot: Inadequate vitamin consumption will lead to suboptimal health and, ultimately, poor athletic performance. Therefore, if vitamin supplements are provided to eliminate a known vitamin deficiency, they will lead to better health and provide a foundation for better training and improved performance. I have seen athletes with the clinical signs of B-vitamin deficiencies and frustrated coaches wondering why those athletes are performing so poorly. A supplement of B-vitamins in these cases has always made the athletes feel better, train better, and perform better. Interestingly, vitamin deficiencies are commonly associated with psychological symptoms (irritability, easy frustration, anger, etc.) that may interfere with the normal athlete-coach relationship, further complicating the potential for effective athletic training.

Clarkson: Insufficient dietary intake of vitamins can impair exercise performance, but taking more than what is recommended does not seem to enhance performance. Often the analogy is made of vitamin use in the body to oil use for an automobile. If an automobile does not have enough oil, engine function will be compromised, but putting in more oil than recommended won't make the engine run any better. Many vitamins serve as cofactors or "helpers" to enzymes. An enzyme may need only one cofactor to accomplish its task—providing more cofactors will not make the enzyme work any better.

Coleman: I, too, believe that a vitamin supplement will improve performance only when it corrects a nutritional deficiency. As an example, I remember an endurance athlete who was taking a medication that increased her requirements for folic acid and vitamin B-12. The athlete developed anemia (due to low serum levels of folic acid and vitamin B-12), and her performance suffered. Supplementation with folic acid and vitamin B-12 corrected the anemia, and the athlete's performance returned to normal.

What is the best way to determine if an athlete's diet is providing the optimal amounts of vitamins?

Benardot: There are three levels of assessment that can provide clues about whether an athlete is at risk for nutrient deficiency. The first level is a dietary intake assessment, which can provide important information about the exposure to vitamins the athlete has from the foods and supplements consumed. If the athlete

requires 60 mg of vitamin C and a nutrient intake analysis consistently indicates an average intake of 40 mg per day, this athlete could be considered at risk for deficiency. However, risk does not mean there is actually a problem, because different people have differences in requirements. For this person, 40 mg per day might be just fine. A low level of vitamin consumption should, however, take the athlete to the next level of investigation, which would be a blood test to see if there is a reduced functional level or storage level of the vitamin. A final confirmation that there really is a problem is the presence of a clinical symptom that can easily be observed. For instance, cracks in the corners of the mouth (angular stomatitis) are a sign of riboflavin deficiency. Whether there are clinical signs or biological values indicating a deficiency is present, a dietary intake analysis is useful for helping to explain why the person has the deficiency and often provides a simple strategy for correcting the problem. Often that strategy is to ensure that the athlete ingests five servings of fruits and vegetables each day and that the diet contains whole grains, lean meat, and dairy products. If energy intake is sufficient (not calorie restricting) and those rules are followed, the diet should be adequate in micronutrients. Vegetarians should check with a nutritionist to be sure that they obtain sufficient amounts of those vitamins usually obtained in meat and dairy products.

Assuming an athlete's regular diet is providing insufficient amounts of vitamins, what do you recommend to improve the athlete's vitamin status? Are vitamins from natural foods better than those from pills?

Clarkson: The total diet is more important than selected vitamins alone. Vegetables and fruits contain a myriad of substances, called phytochemicals, that are important to health, and researchers are far from understanding the full benefits of these phytochemicals. Vitamins from food and from supplements may be the same, depending on the quality control of the supplement manufacturer. However, if vitamins were obtained predominantly from supplements, many valuable phytochemicals that could play important roles in health maintenance would be missing.

Manore: I totally agree. If diet is the problem, then the solution should also be from the diet. There are many ways to achieve a balanced intake of vitamins, minerals, and energy substrates. For instance, we typically derive a large portion of the calcium we consume from milk and milk products, but calcium-supplemented fruit juices and other calcium-rich foods can be readily substituted. Supplements are useful for making sudden improvements in vitamin status if a known deficiency is present or for providing a form of vitamin insurance if the dietary intake is basically sound. However, providing supplements as an alternative to a sound diet can eventually lead to serious deficits in the consumption of other nutrients.

Coleman: As one example of the disadvantages of supplements compared to regular foods, if you take a vitamin C pill, you're missing the dietary fiber, limonene (an anticancer phytochemical), potassium, and energy that you would get if you ate an orange. If athletes choose to use dietary supplements, which are not regulated, I encourage them to look for: products that have USP (United States Pharmacopeia) on the label. This means the supplement passes tests for how well it dissolves and for disintegration, potency (strength), and purity. It also helps to look for nationally known food and drug manufacturers who make their products under tight manufacturing controls.

SUGGESTED ADDITIONAL READING:

Clarkson, P.M. (1998). Exercise and the B vitamins. In: Wolinsky (ed.) *Nutrition in Exercise and Sport*. 3rd ed. Boca Raton, FL: CRC Press, pp. 179-196.

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SHOULD YOU BE TAKING VITAMIN SUPPLEMENTS?

Many athletes consume vitamin supplements on a regular basis, and others worry that perhaps they should. Still, we know that over consumption of vitamins can have toxic effects. So what is the athlete to do? Here are some questions and answers that may help you make the right decisions about vitamin supplementation.

Is it possible that my normal diet contains too few vitamins?

It is unlikely that you are consuming too few vitamins UNLESS:

- n You are restricting your calorie (and vitamin) intake to lose body weight;
- n You have unusual eating habits such as eating too much fast food;
- n You tend to eat on the run, consuming snacks and other foods low in vitamin content;
- n You eat less than five servings per day of fruits and vegetables.
- n You smoke and drink too much alcohol;
- n You have a disease, e.g., pernicious anemia, that reduces absorption or metabolism of vitamins.

If you do have insufficient vitamin intake in your diet, the vitamin shortages are most likely for:

- n Some of the B-complex vitamins—thiamin, riboflavin, niacin, vitamin B-12 (vegetarians only), and especially vitamin B-6 and folate (folic acid, folacin).
- n The antioxidant vitamins—vitamin C, vitamin E, and beta carotene.

How can I know for certain that I have a vitamin deficiency?

- n The first step is to ask a dietitian to provide an analysis of your normal nutrient intake. If you consistently consume lower than recommended amounts of a vitamin or vitamins, you could have a vitamin deficiency. However, this does not prove a deficiency because some people need less than others.
- n The next step is to have a blood test to determine the amount and functional activity of vitamins stored in your body.
- n Final confirmation of a vitamin deficiency would be the appearance of clinical symptoms such as cracks in the corners of your mouth, which suggest a riboflavin deficiency. Unfortunately, many of these clinical symptoms require a long time to develop.

If I suspect that I have a vitamin deficiency, what should I do about it?

- n You should correct deficiencies in vitamin intake by correcting your diet. Getting vitamins from normal foods is better than getting them from supplements because normal foods contain extra nutrients—phytochemicals—that supplements do not contain.
- n Avoid diets that place too heavy an emphasis on any one nutrient, e.g., too much carbohydrate or too much protein, that leads to insufficient intake of vitamin-rich foods.
- n Get help from a dietitian or nutritionist to make sure your diet contains five servings daily of fruit and vegetables and that your diet contains sufficient whole grains, lean meat, and dairy products. (If you are a vegetarian, a dietitian can modify your diet to compensate for the absence of meat and dairy products.) If you follow this advice, your diet should be adequate in vitamins and minerals.

Just for insurance, is it O.K. if I take a daily vitamin supplement?

- n Although it is unlikely that you need such a supplement, it probably will not cause any harm, as long as the supplement contains no more than the Recommended Dietary Allowances (RDA) or Adequate Intake (AI) for vitamins on a daily basis. But remember, if you rely on the supplement for your vitamins, you could be missing out on other important nutrients in normal foods.
- n If you want a “vitamin-insurance policy,” many experts recommend that you only take a multi-vitamin pill every two or three days, not every day. This strategy would minimize the possibility that you might get an overdose of one or more vitamins.

Under what conditions might I consume an overdose of vitamins?

- n If you consume more than the RDA or Upper Limit of vitamin supplements on a regular basis.
- n If you eat many servings of vitamin-fortified foods such as breakfast cereals that contain 100% of the RDA for vitamins and minerals in each serving.

Will vitamin supplements improve my athletic performance?

- n Experts agree that vitamin supplements will improve performance only if the athlete has an existing vitamin deficiency. As indicated earlier, such a deficiency is not common.
- n If you do not have a vitamin deficiency, vitamin supplements will do nothing to improve your performance and will be a waste of money.

SUGGESTED ADDITIONAL READING:

Clarkson, P.M. (1998). Exercise and the B vitamins. In: I. Wolinsky (ed.) *Nutrition in Exercise and Sport*. 3rd ed. Boca Raton, FL: CRC Press, pp. 179-196.

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