

LE Magazine August 2003

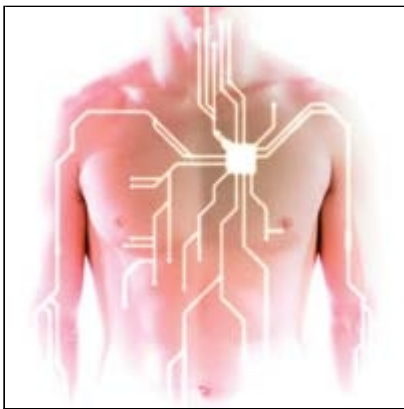
ALL ABOUT SUPPLEMENTS

Glutamine: The Conditionally Essential Amino Acid By Angela Pirisi

Glutamine is one of the 20 amino acids our body uses to build proteins. These proteins are the building blocks for most components of our bodies, including muscles, bones, hair, hormones and more. Glutamine plays a vital role in the proper functioning of many body systems, including the immune and digestive systems. Due to its importance in the body, the use of glutamine supplementation is the focus of intense research efforts.



Of the 20 amino acids in our bodies, nine are considered "essential" and the other 11 are termed "non-essential." The essential amino acids need to be obtained from our diet, as opposed to the non-essential ones, which our body can manufacture on its own. When we eat, the proteins we ingest are broken down by our digestive system into their individual amino acids. By linking amino acids back together in various combinations, our body synthesizes the proteins it needs.



Since we are capable of making glutamine on our own, it was originally labeled a non-essential amino acid. However, most scientists now consider glutamine to be a "conditionally" essential amino acid, because under certain conditions we are unable to make adequate amounts and thus need to obtain it from outside sources. Studies have shown that our body's concentration of glutamine is markedly decreased during times of severe bodily stress, such as during major surgery, burns, starvation, serious infections and even prolonged exercise.^{1,2}

Glutamine is the most abundant amino acid in our bodies, comprising approximately half of the free amino acids in our muscles and blood.³ The majority of our glutamine is manufactured and stored in skeletal muscle. While our bodies synthesize most of the glutamine that we need, we also obtain some from the foods we eat. Practically all proteins we consume contain some amount of glutamine, usually in the order of 4% to 8% of their total amino acid composition. Given the average adult's daily protein intake, we probably

obtain less than 10 grams of glutamine from our diet each day.⁴

Glutamine plays many roles in our body. Research has shown glutamine to be integral in the proper function of our digestive system, our immune system (our ability to fight infection) and our muscular system, to name a few. It acts as a type of fuel for cells, especially for rapidly dividing cells such as enterocytes, colonocytes, lymphocytes and fibroblasts.⁵ During the manufacture of glutamine, a nitrogen molecule is taken from free ammonia in the body, thus it plays a role in protecting our bodies from high levels of ammonia and maintaining proper acid-base balance.^{4,6} When needed, our body can convert glutamine to sugar for energy. Glutamine is also involved in the manufacture of other amino acids, including glutathione, an important intracellular antioxidant.⁴

Can glutamine supplementation help us in our goal of living a longer, healthier life? To explore this, we will examine glutamine's role in its two most active body systems: the digestive and immune systems. We will also discuss the relationship between exercise and glutamine. While a comprehensive review of the research was performed in the preparation of this article, it is important to bear in mind that the references used do not necessarily represent an exhaustive list of published research on glutamine and its use as a supplement.

The digestive system



Numerous studies have shown glutamine to be a key component in the maintenance of healthy intestinal mucosa. In fact, glutamine was once termed "intestinal permeability factor."⁷ The small intestine is by far the greatest user of glutamine in the body. Enterocytes (epithelial cells lining the small intestine) use glutamine as their primary fuel for metabolic function.⁴ It is felt that a lack of glutamine leads to a loss of epithelial cell integrity in the lining of the intestines. This, in turn, may allow toxins and infectious agents to enter the body.⁸ Most research studies concerning glutamine and the gastrointestinal system involve the addition of glutamine to TPN (total parenteral nutrition), a nutritional supplement given to the critically ill. One study showed that the addition of glutamine to TPN solutions reversed intestinal mucosal atrophy.⁹ Although glutamine has been shown to be beneficial when added to TPN solution in critically ill patients, its role in other gastrointestinal disease is still controversial and more studies are needed to determine its potential benefits and drawbacks.

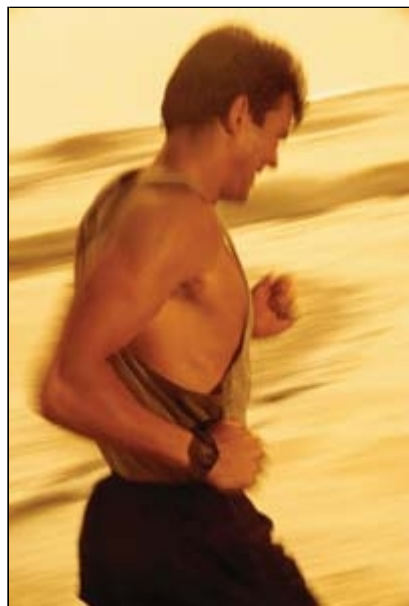


The immune system

Glutamine plays a major role in our infection-fighting "immune" system. Many immune cells, such as lymphocytes and macrophages, use glutamine as an energy source almost as much, if not more than, the amount of glucose they use for energy.^{10,11} Some studies have shown a benefit of glutamine in chemotherapy and bone marrow transplant patients, whom usually have a weakened immune system.¹² Yet other research has shown that glutamine can help reduce infections in critically ill patients.¹³ In addition, glutamine may play a role in enhancing the weakened immune systems of athletes after prolonged strenuous exercise, which is discussed in further detail in the next section.

Exercise

Glutamine regulation may be especially important in athletes, both to help ward off infections and to prevent the breakdown of muscle. Studies have shown that while glutamine levels rise after short-term exercise, they decrease after prolonged periods of exercise.¹⁴ It has been theorized that after exhaustive exercise, such as running a marathon, athletes are at an increased risk of acquiring an infection. This is possibly due to decreased glutamine levels.¹⁵ On the other hand, it should be noted that regular, moderate exercise has been shown to reduce the incidence of illness in sedentary individuals (yet another reason regular exercise can improve your health and longevity).¹⁴



In one study, marathon runners who consumed oral glutamine supplements immediately after and then two hours after a marathon reduced their incidence of developing an upper respiratory tract infection by nearly one-third.¹⁶ Although the findings of this and additional studies are encouraging, other studies have failed to show a direct link between glutamine and specific markers of immune function after strenuous exercise.^{17,18} So, if glutamine does truly have a benefit in preventing infections after physical activity, the exact mechanism is unclear and further research is warranted.

Continued on Page 2 of 2

[Back to the Magazine Forum](#)

ALL ABOUT SUPPLEMENTS

Glutamine: The Conditionally Essential Amino Acid

By Angela Pirisi

Research has shown that glutamine appears to be involved in the regulation of a number of important metabolic processes in skeletal muscle.¹⁹ It is therefore hypothesized that glutamine supplementation can help maintain muscle mass. Under severe stress conditions, when glutamine levels are low, the body may respond by breaking down muscle to obtain glutamine. Therefore, experts believe that if supplemental glutamine is taken during these situations, the unnecessary breakdown of muscle may be prevented.²⁰ In fact, researchers believe that glutamine supplementation may increase protein synthesis in the body.²¹

Overall, it seems that glutamine supplementation can benefit certain athletes, possibly by boosting the immune system and preventing the breakdown of muscle. This may be especially important during times of excessive stress, such as after prolonged strenuous exercise. However, a great deal of information about the role of glutamine during athletic activity is still unclear and will hopefully be clarified by future research.

Dosage

According to the Physicians' Desk Reference (PDR) for Nutritional Supplements, glutamine added to TPN (total parenteral nutrition-intravenous feed) can help the recovery of the critically ill, such as trauma and surgical patients. The recommended dosages for glutamine added to TPN in a hospital setting are 12 grams per day for post-surgical patients and approximately 25 grams per day for severe trauma and infections.

While there are no specific recommendations concerning glutamine supplementation for athletes, the PDR states that those who use oral glutamine supplements for sports or fitness purposes usually consume 1.5 to 4.5 grams per day in the form of L-glutamine.

Proponents of glutamine supplementation have also indicated its consumption for other purposes. For example, in his book *Dr. Atkins' Vita-Nutrient Solution*, the late Dr. Atkins recommended between 5 and 20 grams per day to "stimulate the immune system" when needed, between 2 and 3 grams at the onset of a desire for sweets to help ward off the craving, and up to 40 grams per day for inflammatory bowel disease, leaky gut syndrome, during periods of wound healing or during recovery from a prolonged hospital stay. Dr. Atkins

recommended powdered L-glutamine as the easiest and most economical way to obtain this amino acid.⁷

Although Dr. Atkins stated that none of his patients ever developed side effects from glutamine supplementation, the PDR reports that there have been some cases of constipation and bloating associated with high doses of glutamine in TPN. Furthermore, glutamine is contraindicated in anyone who is hypersensitive to any component of a glutamine supplementation product they plan to take. The PDR also warns that those with kidney or liver problems should be cautious in the use of glutamine supplements and that pregnant or nursing women should avoid glutamine supplementation unless specifically prescribed by their physicians. When taking glutamine supplements, it is probably best to split the recommended dosage into two to four divided servings spread throughout the day.³ As with any vitamin or nutritional supplement, the use of glutamine supplementation should only be done under the supervision of a physician.

Conclusion

Glutamine, the most abundant amino acid in humans, is vital to the proper functioning of our bodies. Research has clearly shown that glutamine is necessary for proper intestinal health and that it plays a major role in fighting infections by acting as a fuel for cells in our immune system. Glutamine supplementation is important for the critically ill and may play a role in helping athletes after prolonged strenuous exercise by decreasing infections and preventing the breakdown of muscle. While the role of glutamine in these and other situations is promising, additional research is needed. The role of glutamine in the body and the potential advantages of glutamine supplementation for both sick and healthy individuals is the focus of on-going intense research efforts throughout the world.



References

1. Hendler, Sheldon S., Ph.D., M.D., & Rorvik, David, M.S. (Editors). PDR for Nutritional Supplements. New Jersey: Medical Economics Company, 2001:189-91.
2. Reinaldo A., et al. Branched-chain amino acid supplementation and the immune response of long-distance athletes. *Nutrition* 2002 May;18(5):376-9.
3. Talbott, Shawn M., Ph.D. A Guide to Understanding Dietary Supplements. New York: The Haworth Press, 2003:414-5.
4. Miller A. Therapeutic considerations of l-glutamine: A review of the literature. *Altern Med Rev* 1999 Aug;4(4):239-48.
5. Vante JP et al. Plasma-amino acid profiles in sepsis and stress. *Ann Surg* 1989 Jan;209(1):57-62.
6. Krebs H. Glutamine metabolism in the animal body. In: Mora J, Palacios R (Editors). *Glutamine: metabolism enzymology and regulation*. Academic Press, 1980:319-29.
7. Atkins, Robert C., M.D. Dr. Atkin's Vita-Nutrient Solution. New York: Simon & Schuster, 1998:167-170.
8. Neu J, et al. Glutamine: clinical applications and mechanisms of action. *Curr Opin Clin Nutr Metab Care* 2002 Jan;5(1):69-75.
9. O'Dwer ST, et al. Maintenance of small bowel mucosa with glutamine-enriched parental nutrition. *J Parenter Enteral Nutr* 1989 Nov-Dec;13(6):579-85.
10. Ardawi MSM, et al. Glutamine metabolism in lymphocytes of rats. *Biochem J* 1983 Jun 15;212(3):835-42.
11. Ardawi MSM, et al. Metabolism in lymphocytes and its importance in the immune response. *Essays Biochem* 1985;21:1-44.
12. Ziegler TR. Glutamine supplementation in bone marrow transplantation. *Br J Nutr* 2002 Jan;87(suppl 1):S9-15.
13. Andrews FJ, et al. Glutamine: essential for immune nutrition in the critically ill. *Br J Nutr* 2002 Jan;87 (suppl 1):S3-8.
14. Castell LM. Can glutamine modify the apparent immunodepression observed after prolonged, exhaustive exercise? *Nutrition* 2002 May;18(5):371-375.
15. Parry-Billings M, et al. A communicational link between skeletal muscle, brain and cells of the immune system. *Intern J Sports Med* 1990 May;11 (suppl 2):S122-8.
16. Castell LM, et al. Does glutamine have a role in reducing infections in athletes? *Eur J Appl Physiol Occup Physiol* 1996;73 (5):488-90.
17. Nieman D, et al. Exercise and immune function. Recent developments. *Sports Med* 1999 Feb;27(2):73-80.
18. Rohde T, et al. Effect of glutamine supplementation on changes in the immune system induced by repeated exercise. *Med Sci Sports Exerc* 1998 Jun;30(6):856-62.
19. Rennie MJ, et al. Amino acid transport during muscle contraction and its relevance to exercise. *Adv Exp Med Biol* 1998;441:299-305.
20. Antonio J, Ph.D., & Stout J., Ph.D. (Editors). *Sports Supplement Encyclopedia Edition 1*. Colorado: Nutricia Institute of Sports Science, 2002:132-3.
21. Hankard RG, et al. Effect of glutamine on leucine metabolism in humans. *Am J Physiol* 1996 Oct ;271 (4 Pt 1): E748-54.

These statements have not been evaluated by the FDA. These products are not intended to diagnose, treat, cure or prevent any disease. The information provided on this site is for informational purposes only and is not intended as a substitute for advice from your physician or other health care professional or any information contained on or in any product label or packaging. You should not use the information on this site for diagnosis or treatment of any health problem or for prescription of any medication or other treatment. You should consult with a healthcare professional before starting any diet, exercise or supplementation program, before taking any medication, or if you have or suspect you might have a health problem. You should not stop taking any medication without first consulting your physician.