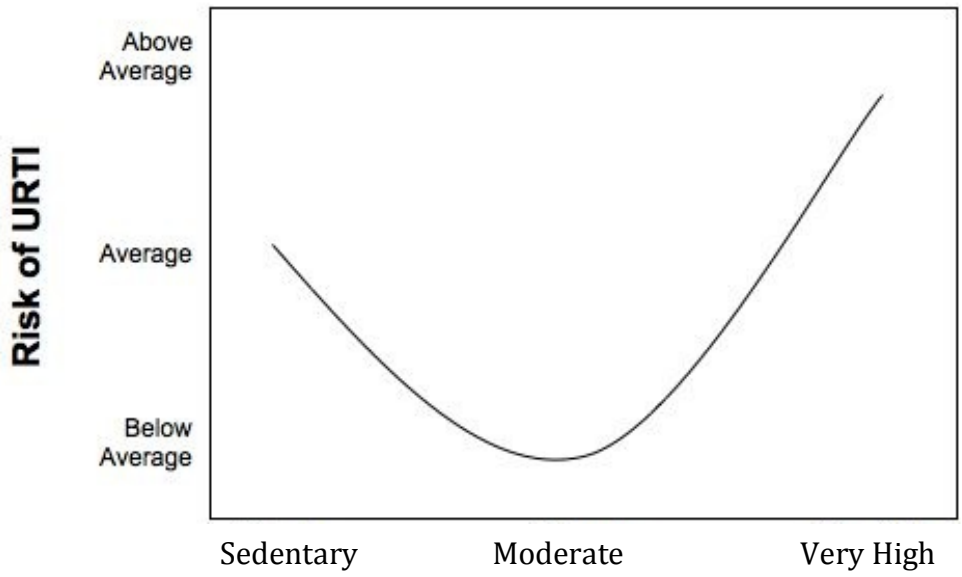
Korey Stringer Institute
University of Connecticut
Preventing sudden death in sport

CAMELBAK®

Immune Function: Basic Considerations of Exercise and Hydration

Summary of Findings

- No firm evidence exists to support or refute the role of hydration in the development or treatment of upper respiratory tract infections (the common cold), but current expert opinion highly recommends keeping properly hydrated to prevent and treat the common cold.
- Currently, no firm evidence exists showing the role of hydration on the immunosuppressive response during exercise and whether maintaining a euhydrated state enhances or further suppresses immune function while exercising.
- Moderate exercise has been shown to enhance immune function whereas prolonged or intense exercise has shown immunosuppressive results.[1–3]
- One mechanism for immunosuppression during prolonged or intense exercise is the release of hormones, such as cortisol, into the blood stream through increase in muscle IL-6.[4–6] Previous studies[7–11] found that dehydration leads to an increase in cortisol levels in the blood.
- Although there is limited evidence showing the direct effects of dehydration on immune function, dehydration has been postulated as one of the possible mechanisms leading to immune dysfunction in marathon runners.[12,13]
- Dehydration has been found to decrease salivary rate and decrease the concentration of salivary immunoglobulin A (s-IgA), which is one of the first lines of defense of the immune function on foreign bacteria.[14–17]



The above figure "J-shaped curve" showing the role of how increasing exercise intensity increases the risk of upper respiratory tract infections.[3]

UCONN

Written By: William Adams, MS, ATC and Douglas Casa, PhD, ATC

Practical Applications

- Maintaining appropriate hydration during exercise will assist in attenuating the rise of cortisol and epinephrine in the blood stream, which has been found to suppress the immune system.
- Any athlete training at high volumes and intensities are more likely to suffer an immunosuppressive response after exercise. Therefore, adequate hydration in these athletes could possibly decrease the magnitude of the immunosuppressive response.
- Endurance athletes such as marathon runners, triathletes, ultra marathon runners training have been noted to be at a particularly high risk of upper respiratory tract infections due to their high volumes of training. These endurance athletes should make an effort to keep properly hydrated while training.

Looking Ahead

- Further research looking at the effects of dehydration on immune function in which dehydration is isolated from exercise during the protocol.
- Of the studies looking at immune function and exercise that include a dehydration protocol, additional studies following the same protocol but including control subjects could help determine whether or not dehydration plays an role in immunosuppression that is additive to exercise.
- Aside from studying immune function in the athletic population, further research looking at the role of hydration on the development, treatment, and prevention of illnesses in general is necessitated.

References

1. Pedersen BK, Hoffman-Goetz L. Exercise and the immune system: regulation, integration, and adaptation. *Physiol. Rev.* 2000;80(3):1055–1081.
2. Gleeson M, Nieman DC, Pedersen BK. Exercise, nutrition and immune function. *J Sports Sci*. 2004;22(1):115–125.
3. Nieman DC. Exercise, infection, and immunity. *Int J Sports Med*. 1994;15 Suppl 3:S131–141.
4. Tønnesen E, Christensen NJ, Brinkløv MM. Natural killer cell activity during cortisol and adrenaline infusion in healthy volunteers. *Eur. J. Clin. Invest.* 1987;17(6):497–503.
5. Mitchell JB, Dugas JP, McFarlin BK, Nelson MJ. Effect of exercise, heat stress, and hydration on immune cell number and function. *Med Sci Sports Exerc*. 2002;34(12):1941–1950.
6. Walsh NP, Whitham M. Exercising in environmental extremes : a greater threat to immune function? *Sports Med*. 2006;36(11):941–976.
7. Maresh CM, Whittlesey MJ, Armstrong LE, et al. Effect of hydration state on testosterone and cortisol responses to training-intensity exercise in collegiate runners. *Int J Sports Med*. 2006;27(10):765–770.
8. Francesconi RP, Sawka MN, Pandolf KB, Hubbard RW, Young AJ, Muza S. Plasma hormonal responses at graded hypohydration levels during exercise-heat stress. *J. Appl. Physiol.* 1985;59(6):1855–1860.
9. Francis KT. Effect of water and electrolyte replacement during exercise in the heat on biochemical indices of stress and performance. *Aviat Space Environ Med*. 1979;50(2):115–119.
10. Few JD. The effect of exercise on the secretion and metabolism of cortisol. *J. Endocrinol.* 1971;51(2):x–xi.
11. Hoffman JR, Maresh CM, Armstrong LE, et al. Effects of hydration state on plasma testosterone, cortisol and catecholamine concentrations before and during mild exercise at elevated temperature. *Eur J Appl Physiol Occup Physiol*. 1994;69(4):294–300.
12. Nieman DC. Marathon training and immune function. *Sports Med*. 2007;37(4-5):412–415.
13. Ohira Y, Girandola RN, Simpson DR, Ikawa S. Responses of leukocytes and other hematologic parameters to thermal dehydration. *J Appl Physiol*. 1981;50(1):38–40.
14. Gleeson M. *Immune Function in Sport And Exercise*. Elsevier Health Sciences; 2006.
15. Fortes MB, Diment BC, Di Felice U, Walsh NP. Dehydration decreases saliva antimicrobial proteins important for mucosal immunity. *Appl Physiol Nutr Metab*. 2012;37(5):850–859.
16. Bishop NC, Blannin AK, Armstrong E, Rickman M, Gleeson M. Carbohydrate and fluid intake affect the saliva flow rate and IgA response to cycling. *Med Sci Sports Exerc*. 2000;32(12):2046–2051.
17. Gleeson M. Mucosal immune responses and risk of respiratory illness in elite athletes. *Exerc Immunol Rev*. 2000;6:5–42.