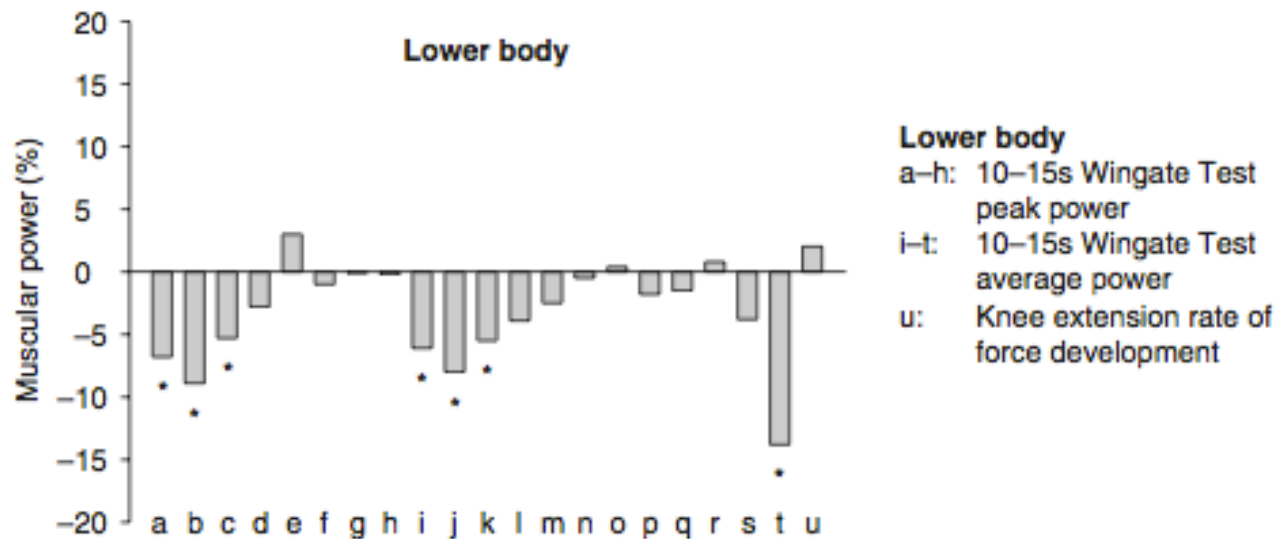


The Influence of Hydration on *Muscular Power*

Summary of Findings

- **Scientific Definition:** Muscular power is defined as the power generated when a muscle engages in a maximal concentric action at the optimal shortening velocity.¹
- Overall the evidence indicates that maintaining hydration enhances performance by attenuating the decreases in muscular power that occur from dehydration.²⁻⁷ Some evidence shows that dehydration has no effect on muscular power⁸⁻¹³ and reasons for these conflicting results are most likely due to the different testing procedures used in these studies to elicit dehydration.
- Interpreting the effects of dehydration on muscle power is difficult due to confounding factors (caloric restriction, hyperthermia, fatigue due to exercise, the test used to assess power, training status, and menstrual status) that can be involved in the experimental protocols examining this topic.¹⁴
- Numerous authors^{2,7,14-16} have postulated that the decrease in muscular power as a result of dehydration is caused by factors affecting the neuromuscular system.
- Of the available literature examining the effects of dehydration on muscle power, a level of 3-4% dehydration reduces muscular power by about 3%.¹⁴
- Body mass losses of 3-4% can occur in exercise lasting 60-90 minutes, especially if an athlete begins practice dehydrated or there are additional external factors affecting sweat rate (environmental temperature, protective equipment/clothing, etc.).



Muscular power changes due to dehydration in controlled studies.¹²

Practical Applications

- Prior to competition, practice, or conditioning sessions, ensure proper hydration to maximize power during activity.
- Proper hydration during activity will assist in preventing any additive effects of dehydration on power losses.
- Athletes participating in sports such as football, basketball, soccer, ice hockey, wrestling, and rugby should maintain adequate hydration to attenuate power losses during

Looking Ahead

- Further research investigating the effects of dehydration on power in isolation from exercise, exercise in the heat, passive heating resulting in increased muscle temperature, or caloric restriction is needed to gain a better understanding of the magnitude on how dehydration affects strength during physical activity.
- Further investigations to determine if greater strength gains in athletes are obtained during strength and conditioning sessions if they are properly hydrated versus if they are dehydrated.

References

1. Knuttgen H, Kraemer W. Terminology and measurement in exercise performance. *J Appl Sport Sci Res.* 1987;1:1–10.
2. Ftaiti F, Grélot L, Coudreuse JM, Nicol C. Combined effect of heat stress, dehydration and exercise on neuromuscular function in humans. *Eur. J. Appl. Physiol.* 2001;84(1-2):87–94.
3. Nielsen B, Kubica R, Bonnesen A, Rassmussen IB, Stokolosa J, Wilk B. Physical work capacity after dehydration and hyperthermia: a comparison of the effect of exercise versus passive heating and sauna and diuretic dehydration. *Scandinavian Journal of Sport Science.* 1981;3:2–10.
4. Webster S, Rutt R, Weltman A. Physiological effects of a weight loss regimen practiced by college wrestlers. *Med Sci Sports Exerc.* 1990;22(2):229–234.
5. Webster S, Rutt R, Weltman A. Effects of typical dehydration practices on performance. *Medicine and science in sports and exercise.* 1988;20:20.
6. Jones LC, Cleary MA, Lopez RM, Zuri RE, Lopez R. Active dehydration impairs upper and lower body anaerobic muscular power. *J Strength Cond Res.* 2008;22(2):455–463.
7. Yoshida T, Takanishi T, Nakai S, Yorimoto A, Morimoto T. The critical level of water deficit causing a decrease in human exercise performance: a practical field study. *Eur. J. Appl. Physiol.* 2002;87(6):529–534.
8. Greiwe JS, Staffey KS, Melrose DR, Narve MD, Knowlton RG. Effects of dehydration on isometric muscular strength and endurance. *Med Sci Sports Exerc.* 1998;30(2):284–288.
9. Jacobs I. The effects of thermal dehydration on performance of the Wingate Anaerobic Test. *International journal of sports medicine.* 1980;1:21–24.
10. Judelson DA, Maresh CM, Farrell MJ, et al. Effect of hydration state on strength, power, and resistance exercise performance. *Med Sci Sports Exerc.* 2007;39(10):1817–1824.
11. Hayes LD, Morse CI. The effects of progressive dehydration on strength and power: is there a dose response? *Eur. J. Appl. Physiol.* 2010;108(4):701–707.
12. Cheuvront SN, Carter R 3rd, Haymes EM, Sawka MN. No effect of moderate hypohydration or hyperthermia on anaerobic exercise performance. *Med Sci Sports Exerc.* 2006;38(6):1093–1097.
13. Viitasalo JT, Kyröläinen H, Bosco C, Alen M. Effects of rapid weight reduction on force production and vertical jumping height. *Int J Sports Med.* 1987;8(4):281–285.
14. Judelson DA, Maresh CM, Anderson JM, et al. Hydration and muscular performance: does fluid balance affect strength, power and high-intensity endurance? *Sports Med.* 2007;37(10):907–921.
15. Fogelholm M. Effects of bodyweight reduction on sports performance. *Sports Med.* 1994;18(4):249–267.
16. Montain SJ, Smith SA, Mattot RP, Zientara GP, Jolesz FA, Sawka MN. Hypohydration effects on skeletal muscle performance and metabolism: a 31P-MRS study. *J. Appl. Physiol.* 1998;84(6):1889–1894.