

EXERCISE IN THE HEAT AND THE PHYSIOLOGICAL RATIONALE BEHIND ACCLIMATIZATION

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DEMANDS

- Exercise in the heat poses a difficult problem to the body
- Balance between preventing hyperthermia and maintaining an adequate fuel supply to the muscles.

HYPOTHALAMUS

- Temperature Regulation

HEAT LOSS

- Radiation
- Convection
- Conduction
- Evaporation

ACUTE RESPONSES

- Increase Skin vasodilation/ Visceral vasoconstriction
- Increase Core Temperature
- Increase Sweat Response
- Increase HR
- BP Maintenance
- Increase Lactate production
- Changes in Substrate Metabolism

FLUID LOSS

- 2-3L per hour during exercise in the heat
- Hypo hydration/ Dehydration
- Hyperthermia
- Inability to use cooling mechanisms in extreme environments

PERFORMANCE IMPLICATIONS

- Less substrate availability
- Increased lactate production
- Critical Core temp
- Skeletal muscle recruitment impaired

STRATEGIES TO REDUCE EFFECTS

- Pre Cooling
 - Lower Core Temperature
- Clothing
 - Light weight/ little as possible

NUTRITIONAL STRATEGIES

- Hyper hydration
- Hydration
- Only replace 30-70% of sweat losses
- Rehydration
- CHO Loading

WET BULB GLOBE TEMPERATURE (WBGT)

- Estimation of heat stress, useful when determining cooling methods and necessities in modern sporting situations.

ACCLIMATISATION

- Repeated exposures to the heat results in adaptations within the body that make the athlete less susceptible to the demands imposed by exercise in the heat.

STRATEGIES AND DURATION

- Suggested 7-14 days
- Major adaptations plateau after 14 days

ADAPTATIONS

- Improved skin blood flow
- Lower HR at given exercise levels
- Effective distribution of cardiac output
- Reduction in sweating threshold
- Increased distribution of active sweat glands
- Increased sweat rate

ADAPTATIONS

- Reduction in loss of water and electrolytes from kidneys (Decreased [salt])
- Better maintenance of core temperature
- Increased sweating sensitivity to increasing core temperature
- Less reliant on CHO metabolism

- Buono, M. W., A. (2000). Effect of hypohydration on core temperature during exercise in temperate and hot environments. *European Journal of Physiology*, 440, 476-480.
- Burke, L. (2001). Nutritional needs for exercise in the heat. *Comparative Biochemistry and Physiology - Part A: Molecular & Integrative Physiology*, 128(4), 735-748.
- Casa, D. (1999). Exercise in the heat. 1. Fundamentals of Thermal physiology, performance implications, and dehydration. *Journal of Athletic Training*, 34(3), 246.
- Cheung, S. M., T. (1998). Heat Acclimation, aerobic fitness, and hydration effects on tolerance during uncompensable heat stress. *Journal of Applied Physiology*, 84(5), 1731-1739.
- Hargreaves, M. H., J. (2003). *Physiological basis of performance*. NSW: Mc Graw Hill Australia.
- Hue, O. V., B. Galy, A. Costes, O. (2004). Effect of 8 days acclimation on biological and performance response in a tropical climate. *Journal of Sports Medicine and Physical Fitness*, 44(1), 30.
- Jentjens, R. W., A. Jeukendrup, A. (2002). Heat stress increases muscle glycogen use but reduces the oxidation of ingested carbohydrates during exercise. *Journal of Applied Physiology*, 92.
- Mac Donald, R. (2002). Heat Acclimatisation strategies for endurance athletes. *Modern Athlete and Coach*, 40(1).
- Maresh, C. G.-B., C. Armstrong, L. Judelson, D. Hoffman, J. Castellani, J. Kenefick, R. Bergeron, M. Casa, D. (2003). Effect of hydration status on thirst, drinking, and related hormonal responses during low intensity exercise in the heat. *Journal of Applied Physiology*, 97, 39-44.
- Maughn, R. S., S. (2004). Exercise in the heat: challenges and opportunities. *Journal of Sports Sciences*, 22(10), 917(911).
- Mc Ardle, W. K., F and Katch, V. (2001). *Exercise Physiology. Energy, Nutrition and human Performance*. (5th ed.). Maryland: Lippincott Williams and Wilkins.
- Montain, S. L., JE. Latzka, WA. Sawka, MN. (1997). Aldosterone and Vasopressin responses in the heat: hydration levels and exercise intensity effects. *Medicine and science in sports and exercise*, 29(5), 661-668.
- Nielson, B. H., T. Bidstrup, F. Gonzalez-Alonso, J. Christoffersen, G. (2001). Brain activity and fatigue during prolonged exercise in the heat. *European Journal of Physiology*, 442, 41-48.
- Nielson, B. N., L. (2003). Cerebral Changes During Exercise in the Heat. *Sports Medicine*, 33(1), 1-11.
- Nielson, B. S., S. Christensen, N. Warberg, J. Saltin, B. (1997). Acute and adaptive responses in humans to exercise in a warm humid environment. *European Journal of Physiology*, 434(1).
- Parkin, J. C., M. Zhao, S. Febbraio, M. (1999). Effect of ambient temperature on human skeletal muscle metabolism during fatiguing submaximal exercise. *Journal of Applied Physiology*, 86(3), 902-908.
- Sparling, P. M.-S., M. (1999). Keeping Sports Participants Safe in Hot Weather. *The Physician and Sports Medicine*, 27(7).
- Tucker, R. R., L. Harley, Y. Noakes, T. (2004). Impaired exercise performance in the heat is associated with an anticipatory reduction in skeletal muscle recruitment. *European Journal of Physiology*, 448, 422-430.
- Yates, L. (2004). Climate control: acclimatising to the heat. *Sports Coach*, 27(1), 23-25.