VARIABILITY IN THE SWEATING RATE AND SWEAT SODIUM CONCENTRATION OF ULTRA-ENDURANCE TRIATHLETES DURING EXERCISE

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ABSTRACT

During competition Ironman-distance triathletes can lose large amounts of fluid and sodium through sweating. To date no studies have investigated the variability in sweating rate and sweat sodium concentration in heat-acclimated ironman triathletes during exercise. PURPOSE: Determine the variability in sweating rate and sweat sodium concentration in heat-acclimated ironman triathletes during exercise. METHODS: Three to seven days prior to competing in the Ironman World Championship in Hawaii, 71 heat acclimated subjects (48 male, 23 female, 42.1 ± 1.4 y) cycled a stationary ergometer for 30 min at 70-75% of maximum heart rate, following an 8-min warm-up. Sweat rate was calculated from the change in body weight. An absorbent patch (10 x 12cm) was placed on the right forearm and scapula for sweat collection during the 30 min trial. Sweat sodium concentrations were subsequently determined using chemical analysis (Nova 5, Waltham, MA). RESULTS: Absolute sweat rate was 1.4 ± 0.1 L·hr⁻¹ with a coefficient of variation (CV) of 30.8%. Between subject variability was similar when adjusted for body weight (19±1.7 mg·kg⁻¹·hr⁻¹, CV = 28.5%). Sweat sodium concentrations for the arm and back were 39.5±2.0 mEq·L⁻¹ (CV=42.6%) and 47.2±2.3 mEq·L⁻¹ (CV=41.2%), respectively. Estimated regional sodium loss (whole body sweating rate x regional concentrations) was 56.5 ± 3.9 mEq·hr⁻¹ and 66.8 ± 4.5 mEq·hr⁻¹ for the arm and back, respectively. CONCLUSION: These results demonstrate that there is large variation in both the sweating rate and sweat sodium concentration of ultra-endurance athletes.

INTRODUCTION

- An Ironman-distance race encompasses a 3.86 km swim, a 180.2 km bike, and a 42.2 km run and can take up to 17 hours to complete.
- Sweating rate in humans can exceed 1.8 L·hr⁻¹ during exercise in the heat (1).
- Sweat sodium concentration in untrained heat acclimated individuals ranges from less than 10 to over 60 mEq·L⁻¹ (2).

There is a considerable amount of variability in the sweating characteristics of moderately trained individuals when exercising at a low intensity in a temperate environment (3).

- The variability in the sweating rate and sweat sodium concentration of heat-acclimated ultra-endurance athletes during exercise in a warm environment is currently unknown.

PURPOSE

Determine the variability in sweat sodium concentration and sweating rate in Ironman-distance triathletes during exercise in a warm environment.

METHODS

Subjects

- A total of 71 heat acclimated men (n=48) and women (n=23).
- All subjects were registered to compete in the 2003 Ironman World Championship in Kailua-Kona, HI three to seven days after the exercise trial.

METHODOLOGY

- Trials were performed in a warm, outdoor environment (26.4 ± 0.4°C WBGT) and subjects were fan cooled (3.5 ± 0.4 m·s⁻¹) during the trial.
- All subjects were fan cooled (3.5 ± 0.4 m·s⁻¹) during the trial.

- Skin-fold thickness was measured prior to exercise using Harpenden calipers (Model HHS3, British Indicators, UK). Percent body fat was calculated using the Jackson and Pollock 5-site method (4, 5).
- Body mass was measured (A & D Medical, Life Source Prof II Scales, Model UC-323, Milpitas, CA) before and after the exercise trial.
- Subjects cycled at 70-75% of heart rate maximum for 30 minutes on a stationary ergometer following an 8 minute warm-up.
- All subjects were fan cooled (3.5 ± 0.4 m·s⁻¹) during the trial.

- A breathable waterproof sweat patch (10 x 12cm) was utilized to capture sweat from the right forearm and upper back during the trial.
- Chemical analysis (Nova 5, Waltham, MA) of the sweat was completed to determine sweat sodium concentration.

- The variability in the sweating rate and sweat sodium concentration of heat-acclimated ultra-endurance athletes during exercise in a warm environment is currently unknown.

There is a large amount of variability in the sweating rate (CV~30%) and sweat sodium concentration (CV~40%) of heat acclimated ultra-endurance triathletes during exercise in a warm environment.

RESULTS

- There is a high correlation between regional sweat (Na) of the arm and back (r=0.83, p<0.01, two-tailed).
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CONCLUSION

- Sweating rate in humans can exceed 1.8 L·hr⁻¹ during exercise in the heat (1).
- Sweat sodium concentration in untrained heat acclimated individuals ranges from less than 10 to over 60 mEq·L⁻¹ (2).
- The variability in the sweating rate and sweat sodium concentration of ultra-endurance athletes is currently unknown.

REFERENCES

3. previous scientific studies.

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