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Fluid Loss in Recreational Surfers

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Abstract

Purpose: Activity in an aquatic environment versus a land-based environment elicits different responses to thermoregulation and hydration. The sport of surfing is unique because surfers wear wetsuits and other protective garments to practice in varying climates and at different exercise intensities, all of which may increase body temperature and sweat rate. The purpose of this study was to quantify fluid loss in recreational surfers, and to analyze the effects of water temperature, air temperature, exercise intensity, duration, and garment thickness on the total amount of fluid lost during a surf session.
Methods: 255 male and 53 female recreational surfers were recruited from San Diego, Costa Rica, and Australia to participate in the study. Subjects' hydration status was assessed by comparing the average of three measurements of nude body mass pre- and post-surf session using a portable scale (SECA, CA, USA). Heart rate (HR), used as an index of exercise intensity, was measured throughout the session using a Polar FT1 receiver and T32 transmitter. Environmental conditions and surf characteristics were obtained prior to each subjects' surf session at their beach location using information directly from the National Oceanic and Atmospheric Administration's buoys located offshore (Surfline.com).
Results: A statistically significant difference between average pre-weight (73.08 ±11.88 kg) and average post-weight (72.48 ± 11.78) was observed (0.60 ± 0.55, p<0.01). On average, surfers lost 0.82% body weight. Air temperature, HR, and garment thickness were not associated with changes in fluid loss. Water temperature was associated with fluid loss; for every 5 degree increase in water temperature, there was a 0.23 kg (SE=0.014; p<0.01) increase in fluid loss. Duration was also associated with fluid loss and for every 10 minute increase in session duration, there was a 0.06 kg (SE=0.001; p<0.01) increase in fluid loss. The regression model accounted for 25% (r^2=0.25) of the variability in fluid loss among surfers.
Conclusion: The findings of this study suggest that prolonged surfing at high environmental temperatures can result in significant body water deficits. Because there is no opportunity to rehydrate during the sport, surfers must properly hydrate before surfing to avoid the detrimental effects of dehydration.

Background

- Activity in an aquatic environment versus a land-based environment elicits different responses to thermoregulation and hydration.
- Exercise in the aquatic environment is unique when compared to land-based exercise due to the body being immersed in water, leading to skin temperatures becoming congruent with water temperatures (Sinclair 2012).
- Although heat exchange in water sports occurs mainly through conduction and convection, a large amount of fluid may be lost as sweat (Macaluso 2011).
- The combined effects of ambient conditions and exercise intensity are the thermal loads that are greatly related to sweat rate during water sports (Godek 2005, Maughan 1995)
- In surfing as well as other aquatic sports that may experience extreme heat loss, athletes wear wetsuits to reduce convective heat loss due to cold-water exposure (Wakabayashi 2007).
- Wetsuits are made out of neoprene, which keeps the body warm by reducing convective heat loss and providing thermal insulation (Naebe 2013), potentially leading to an increase in sweat production.
- A body water deficit of 2% or greater is the threshold at which exercise performance becomes compromised (Sawka 2015, Cheuvront et al 2004).
- In states of dehydration, core temperature and cardiovascular strain may increase (Sinclair 2012).
- Dehydration has been proven to deteriorate aerobic, cognitive and motor functioning (Sinclair 2012).
- With the reported detrimental effects on both performance and health parameters, it is important to understand the effects of surfing activity on hydration.

Purpose

- The purpose of this study was to examine the relationship between water temperature, air temperature, exercise intensity, and different garments worn during surfing, to the amount of fluid lost in recreational surfers during a surf session.
- We hypothesized that increases in exercise intensity, water and air temperature, and wetsuit thickness would cause increases in fluid loss among surfers.

Methods

Subjects:
- n=308, 255 males and 53 females
- Ages 18-65 years old
- At least 1 year of surfing experience

Measurements / Equipment:
- The average of three measurements of pre- and post-nude weight was measured to the nearest 0.1 kg using a portable scale (SECA, CA, USA) on a leveled surface.
- Heart rate (HR) was measured throughout the surf session using a Polar T31 HR sensor and a Polar FT1 HR monitor receiver (Polar Electro Inc., NY, USA)
- Environmental conditions (air temp. and water temp) as well as surf characteristics (swell size, interval, and direction) were obtained directly from the National Oceanic and Atmospheric Administration's buoys located offshore (Surfline.com).

Protocol:
- Participants were be asked to urinate in order to void the body of urine and prevent fluid loss due to urination in the water during the surf session, as well as wet their hair in order to mimic the saturation of their hair following the surf session
- Three measurements of nude weight (kg) were measured and recorded prior to the surf session.
- Subjects were fitted with a a Polar T31 HR sensor over the sternum and a Polar FT1 HR monitor receiver (Polar Electro Inc., NY, USA)
- Environmental conditions, surf characteristics, and participant info (garment type/thickness) were recorded
- Subjects were instructed to surf as long as they wanted and post-weight was measured at the end of the surf session and used to calculate total fluid loss

Statistics:
- A paired T-test was used to determine differences in pre- and post-weight
- Multivariable linear regression was used to determine factors associated with fluid loss
- Significance was set at a p-value < 0.05

Results

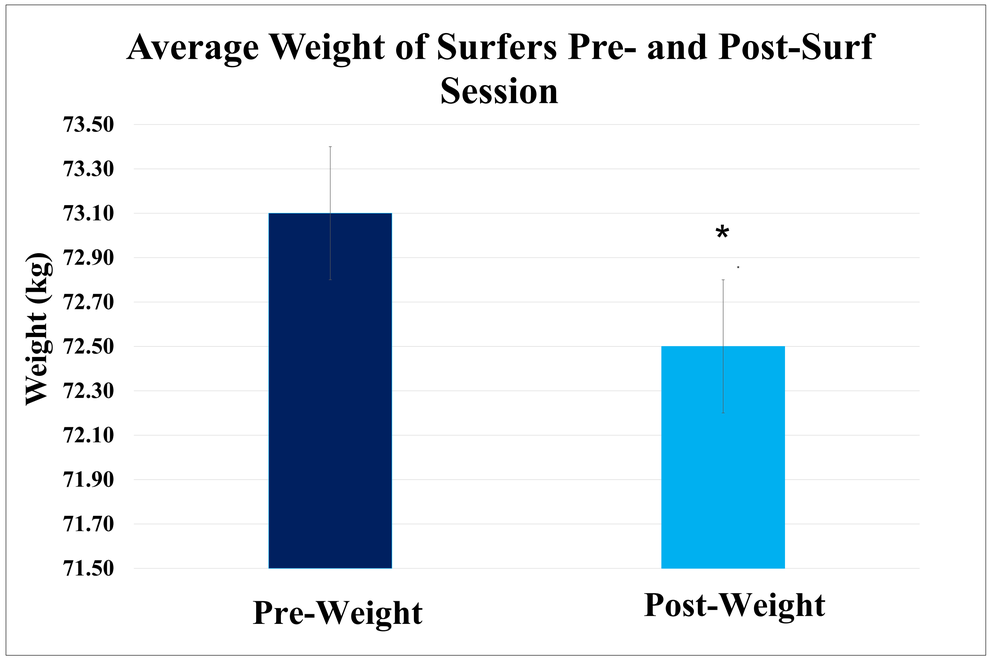

Figure 1: Average post-surf weight (72.05±11.76 kg) was significantly lower than pre-surf weight (73.10±11.86 kg) with an average of 0.60 ± 0.55kg (0.82% body weight loss) decrease in body weight during a surf session. Error bars represent one standard deviation in the positive and negative direction. Asterisk (*) indicates significance at a p-value < 0.05.

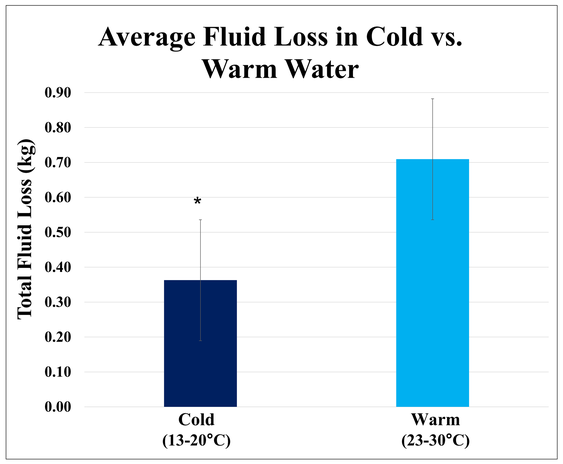

Figure 2: Average fluid loss (kg) of surfers in cold water (0.71±0.57 kg) versus warm water (0.36±0.43 kg). classified as temperatures ranging from 23-30°C. Error bars represent one standard deviation in the positive and negative direction. Asterisk (*) indicates significance at a p-value < 0.05.

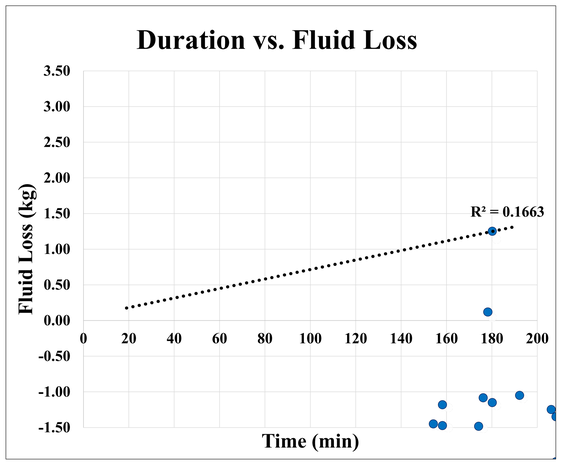

Figure 3: Fluid loss (kg) as a function of number of minutes surfed by each subject (n=308). R^2=0.1663

Subject Characteristics

Sex	N	Age(yrs)	Height(m)	Mass(kg)	Years Surfed	Competency (1-10)	Mean HR	Duration (min)
Male	255	35.3±10.8	1.78±0.96	76.06±10.48	16.31±11.12	6.20±1.64	125.46±15.92	83.68±34.59
Female	53	30.1±7.5	1.68±0.11	58.86±6.70	9.47±6.73	5.19±1.68	125.52±15.99	77.92±30.67
Total	308	34.4±10.5	1.76±0.11	72.90±12.32	15.14±10.80	6.02±1.69	125.47±15.91	82.69±33.97

Results

- In multivariable regression, water temperature, body mass index (BMI) and surf session duration were associated with fluid loss.
- For every 5 degree Celsius increase in water temperature, there was a 0.23 kg (SE=0.014; p<0.001) increase in fluid loss
- For every 10 minute increase in session duration, there was a 0.06 kg (SE=0.001; p<0.001) increase in fluid loss.
- For every one unit increase in BMI, there was a 0.025 kg (SE=0.008; p<0.001) increase in fluid loss.
- Air temperature, HR, and garment thickness were not independently associated with fluid loss.
- Water temperature, air temperature, session duration, BMI and heart rate accounted for 27% of the variability in fluid loss among surfers.

Conclusion

- Based on these findings, it appears that surfing at warm water temperatures for a prolonged period of time may result in dehydration at the level at which health and exercise performance may become compromised.
- Because there is no opportunity to rehydrate during a session, surfers must properly hydrate prior to surfing in order to avoid the detrimental effects of dehydration on health and performance.

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