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Effects Of Ice Slurry Consumption During A Warm-Weather Road Race

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Context: Ice slurry consumption before exercise has been shown to affect temperature responses and performance. However, no study has examined the effects of ice slurry consumption during competitive exercise. Objective: To determine the physiological and perceptual responses to consuming ice slurry during intense warm-weather running. Design: Cohort field study. Setting: 2013 Falmouth Road Race (11.2 km; Falmouth, MA, WBGT: 27.04 ± 1.20 °C). Patients or Other Participants: 28 race participants recruited prior to the race. (26 males, 2 females, mean \pm SD; 37 ± 11 years, 74.8 ± 14.3 kg) Subjects were allocated into two groups, ice slurry group (IS; N = 14) and non-ice slurry group (CON; N = 14). <u>Intervention(s)</u>: During the race individuals in IS were offered 8oz of ice slurry containing carbohydrate and electrolytes (Core Cooldown Inc.) at 3.2 km, 6.4 km, and 9.6 km. Main Outcome Measure(s): Within 40 days of the race, subjects completed VO2max testing. On race day subjects reported for pre-race measures including gastrointestinal temperature (TGI), body mass and urine specific gravity (USG). Subjects also completed inventories of thirst, thermal sensation and the Environmental Symptoms Questionnaire-14 (ESQ). Both groups were allowed to consume fluids ad libitum during the race. Wet bulb globe temperature (WBGT) was recorded at the finish line. Immediately following the race, measurements of TGI, USG, body mass, thirst, thermal sensation and ESQ were obtained. Finish-time was recorded. Independent sample t-tests were used to compare

physiological and performance measures between groups. Mann-Whitney U tests were completed to compare perceptual responses between groups. Results: No differences were observed between groups for VO2max (IS: 50.38 ± 4.91 ml·kg-1·min-1, CON: 52.86 ± 7.21 ml·kg-1·min-1, p = 0.339), speed at VO2max (IS: 14.6 ± 0.98 km·h-1, CON: 15.3 ± 1.3 km·h-1, p = 0.112), body mass (IS: 75.01 ± 16.12 kg, CON: 74.64 ± 12.81 kg, p = 0.947) or age (IS: 39 ± 12 years, CON: 35 ± 10 years, p = 0.365). IS consumed 6.9 \pm 3.4 g/kg ice slurry during the race. No differences were observed for post-race TGI (IS: 39.79 \pm 0.73 °C, CON: 39.47 \pm 0.72 °C, p = 0.277), change in TGI (IS: 2.58 ± 0.99 °C, CON: 2.41 ± 0.73 °C, p = 0.669), post-race USG (IS: 1.009, CON: 1.008, p = 0.801), or finish time (IS: 55.82 min, CON: 52.53 min, p =0.216). No difference was observed in thermal sensation (median [25th, 75th percentile] IS: 6 [5.5, 6.5], CON: 6 [5, 7], p = 0.176). IS reported significantly lower perceptions of thirst (IS: 5 [3, 7], CON: 6 [4, 8], p = 0.003) and ESQ scores (IS: 9 [2, 16], CON: 16 [7, 25], p = 0.010). Conclusions: Ice slurry consumption during exercise did not result in differences for perceived thermal sensation, hydration indices or TGI . However, IS reported lower thirst and fewer symptoms on the ESQ. Therefore, within the context of a summer road race and when race times were similar, runners who consumed ice slurry finished with fewer heat stress symptoms than CON.

Use Of The Discomfort Index (DI) As An Alternative Heat Stress Index (HSI)

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Context: For years the Wet Bulb Globe Temperature (WBGT) has been accepted as the "gold standard" for use in Heat Stress Indices (HSI). Currently, use of the WBGT in HSI's is recommended by organizations such as the National Athletic Trainers' Association (NATA), American College of Sports Medicine (ACSM), Department of Defense (DOD), and some local and state organizations. The discomfort index (DI) is currently used in other countries to develop HSI's, most notably in Israel. DI is calculated by using the equation 0.5 dry bulb (DB) + 0.5 wet bulb (WB). This measurement may be an alternative to WBGT Objective: To determine strength of relationship of the DI with WBGT and to propose a scale based on DI. Design: Prospective epidemio logical design. Setting: Interscholastic institutions from five geographic regions in the state of Georgia (North, Metro Atlanta, Central, Southeast, Southwest) Patients or Other Participants: Interscholastic football athletes from 23 schools in the state of Georgia for August, 2009-2011 seasons. Intervention(s): An ATC was identified at each school and recorded all athlete-exposure (AE), Exertional Heat Illness (EHI), and environmental conditions. EHI types were identified as heat cramps (HC), heat exhaustion (HE), heat syncope (HS), and heat stroke (STR) as defined by the NATA Position Statement. Due to the low number of HS's, HS and HE were combined to form one variable (HS/HE). Main Outcome Measure(s): Injury Rates (IR's) were calculated for all injuries for which environmental data were



available. IR's were calculated using the equation # of EHI's/ AE x 1000. DI's were calculated using raw environmental data and the previously mentioned equation. Pearson Correlation was used to determine the strength of relationship between DI and WBGT. IR's were plotted in 1° Fahrenheit (F) increments to determine possible cut points for the development of an HSI scale. Results: There were 460 EHI's for which environmental data were available. Of those, 349 were HC's and 111 were HS/ HE. The R2 between WBGT and DI was 0.917. Major cut points using HS/ HE IR were noted at a DI of 79, 82, 88, and 91 degrees F. We defined cut points as those temps where IR increased by a factor of at least 2. Conclusions: These data demonstrated a strong relationship between WBGT and DI, suggesting implementation of a HSI using DI a good alternative. This study confirms previous data collected by the DOD, but is specific to an athletic setting. Use of a HSI using DI may be favorable, as it is a simpler scale and a value that could be easily reported by organizations such as the National Weather Service and the National Oceanic and Atmospheric Administration-ultimately more easily accessible to the general public. Further studies are needed to determine best practice with DI. This project was funded by the NATA Research & Education Foundation.

Effect Of Educational Intervention On Hydration Behaviors, Status, And Knowledge In High School Football Players Kanemura K, McDermott BP,

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Context: Hypohydration can negatively affect athletes, declining athletic performance and increasing heat-illness risk. Hydration education could enhance athletes' behavior in maintaining proper hydration, but effects remain unclear. **Objective:** To assess the short- and long-term effect of a one-time educational intervention on hydration behaviors, status, and knowledge in high school football players. Design: Randomized controlled trial. Setting: In-season American football. Patients or Other Participants: Fortyone high school football players (15.9 ± 0.9 y, 176.0 ± 7.5 cm, 87.5 ± 25.1 kg, 15.9 ± 7.5 % body fat) voluntarily participated. Intervention(s): Participants were randomly assigned to an educational intervention (EI) or control group (NI). The EI consisted of a 5-minute presentation on the importance of hydration, quick self-assessment techniques, and hydration status feedback from baseline data. Participants in EI group were provided a personal water bottle. A baseline data collection consisted of 48-hour fluid intake logs, urinalysis and questionnaires. The EI occurred 4 days post-baseline and data collection was repeated 3 days and 3.5 weeks post-EI on the same day of the week. Main Outcome Measure(s): Participants provided a small urine sample prior to practice for urine color (Ucol) and urine specific gravity (USG). Participants recorded their fluid intake for 48-hour prior to data collection using fluid intake logs. Twenty-four-hr averages for total fluid consumed (FC) and water consumed (WC) were calculated. Written questionnaires quantified hydration

knowledge and habits. Results: The EI and NI groups were not significantly different at baseline for Ucol, USG, FC, WC, hydration knowledge or habits (P > 0.05). There was a significant group x time interaction for Ucol (P < .001) and USG (P < .001). USG at baseline (EI: $1.026 \pm .006$; NI: $1.022 \pm .009$), data collection 2 (EI: $1.018 \pm .010$; NI: 1.026 ± 0.007) and data collection 3 (EI: $1.022 \pm .009$; NI: $1.025 \pm .007$) demonstrated our responses. A similar interaction was seen with FC (P =.05) and WC (P < .001). Compared to NI, EI participants increased WC from baseline (EI: $1289.5 \pm .768.8$ mL; NI: 1109.8 ± 651.8 mL) to data collection 2 (EI: 2173.9 ± .893.9 mL; NI: 1229.0 \pm 665.3 mL), but were similar to baseline by data collection 3 (EI: 1.560.8) ± .881.0 mL; NI: 1075.6 ± 580.3 mL). Overall, between baseline and data collection 2, EI increased 19% in FC, while NI showed a 6% FC decrease. Our surveys demonstrated no significant differences over time or between groups (P>.05). Conclusions: A 1-time EI in high school football players improved hydration status and behaviors temporarily despite no increases in hydration knowledge. Our results demonstrated that EI participants increased FC by drinking more water, and this led to improved hydration status. The benefits of our EI did not persist and were not present roughly 3 weeks following EI.



The Influence Of Intermittent Hand Cooling On Core Body Temperature And Performance In The Heat While Wearing An American Football Uniform Sundeen MW, Huggins RA, Adams WM, Vandermark LW, Dempsey DM, Adams JE, Murray KP, Stearns RL, Casa DJ: Korey Stringer Institute, Department of Kinesiology, University of Connecticut, Storrs, CT

Context: Fluid replacement and cooling during exercise have been shown to improve the ability to thermoregulate during exercise in the heat. Wearing an American football uniform increases heat storage and presents a challenge to optimal cooling. New modalities such as peripheral cooling may reduce core body temperature and improve performance in the areas of power, speed, agility, reaction time, and balance. **Objective:** To determine the effect of intermittent hand cooling with and without fluid replacement on sport-specific performance measures. Design: Randomized crossover design. Setting: Research laboratory. Patients or Other Participants: Thirteen males (age: 24 \pm 3yrs, height: 179 \pm 5cm, body mass: 82.6 ± 9.8 kg) performed three separate 90-minute treadmill exercise bouts in a hot environment (39°C, 40%RH) while wearing an American football uniform. Intervention: Participants were randomly allocated to hand cooling (HC), HC with fluid replacement (HCF), and no cooling (CON) in a counterbalanced order. Participants performed HC treatment using a negative pressure device (~140mmHg) on 1 hand every 12th minute of exercise for 3 minutes. Main **Outcome Measure(s):** Participants completed sprint speed on a non-motorized treadmill (Sprint), foot speed count (Count), counter movement vertical jump (VJ), reaction time (React), and modified balance error scoring system (BESS) performance battery before

(PRE) and after (POST) exercise. TRE was measured PRE and POST exercise. A repeated measure ANOVA for condition by time with post-hoc Bonferroni tests set at ($\alpha \leq 0.05$) were utilized to compare differences. Mean differences with 95% confidence intervals, effect sizes (MD, 95% CI, ES) and percent change in performance measures (% Δ) PRE to POST ($\%\Delta$, 95% CI, ES) were used to compare performance across conditions. Results: POST TRE for HCF $(38.64 \pm 0.39^{\circ}C)$ was significantly different than CON ($39.24 \pm 0.49^{\circ}$ C; p = 0.005, ES = 0.61) but not HC (38.86) $\pm 0.45^{\circ}$ C; p = 0.66 ES = 0.25). POST TRE for HC was not different than CON (p = 0.111, ES = 0.41). Sprint $\%\Delta$ [HCF-CON] was 4.99%, (95% CI = -0.05 to 10.04), ES = 0.73, [HCF-HC] was 2.12%, (95% CI = -2.93 to 7.17), ES = 0.20, and [HC-CON] was 2.88%, (95% CI = -2.17 to 7.92), ES = 0.26.Count % Δ [HCF-CON] was 3.77%, (95% CI = -2.77 to 10.31), ES = 0.31,[HCF-HC] was 2.06%, (95% CI = -8.59 to 4.48), ES = 0.25, and [HC-CON] was 5.83%, (95% CI = -0.71 to 12.37), ES = 0.44. React % Δ for [HCF-CON] was -5.96%, (95% CI = -14.10 to 2.17), ES = 0.51, [HCF-HC] was -7.10%, (95% CI = -15.23 to 1.03), ES = 0.46,and [HC-CON] was 1.14%, (95% CI = -6.99 to 9.27), ES = 0.08. BESS Δ score [HCF-HC] was -21%, (95% CI = -53 to 12), ES = 0.46, [HC-CON] was -17%, (95% CI = -49 to 16), ES = 0.27, and[HCF-CON] was -37%, (95% CI = -70 to -5), ES = 0.53. Conclusions: HCF significantly reduced TREC POST. Furthermore, HCF resulted in improvements in % Δ for Sprint and React compared to CON. Reduced thermal strain in the HCF condition may have allowed for a greater effort during performance tasks POST.

The CoolShirt System[™] Aids Thermoregulation During Exertion In A Hot Environment Stamatis P, Powers ME: Marist College, Poughkeepsie, NY, and Orthopedic Associates of Dutchess County, Poughkeepsie, NY

Context: The incidence of heat illness is greatest in athletes who begin training in late summer when ambient temperature and relative humidity are at their highest. The risk of heat illness is even greater in football, as the clothing and equipment present a significant challenge to thermoregulation. Manufacturers of the CoolShirt System[™] claim it can help manage thermoregulation in extreme environments and prevent heat-related illnesses. However, research regarding the efficacy of this system is very limited. **Objective:** The purpose of this study is to determine if the CoolShirt System[™] will aid thermoregulation during exercise in a warm environment. Design: Randomized crossover design. Setting: Data was collected in a temperature controlled research laboratory. Patients or Other Participants: Nine healthy male varsity and recreational athletes (age = 22.00 ± 3.32 y, mass = 83.27 ± 9.26 kg, height = 179.49 ± 5.54 cm) who were acclimated to a warm environment volunteered to participate. Intervention(s): Each subject was assessed for body mass (BM), heart rate (HR) and core temperature (Tcore) during a bout of exercise in a warm environment while wearing football equipment and clothing under two conditions, CoolShirt System[™] (Cshirt) and cotton T-shirt (Tshirt), separated by a period of one week. The exercise protocol consisted of three sets of ten maximal effort 10-second sprints with 30-second of active recovery on a Monark 834E cycle ergometer in a room maintained at 35°C. The three sets were separated by 5-minute of passive recovery in the same warm environment. Main Outcome Measure(s):



Tcore was measured prior to and during exercise using a CorTemp Disposable Temperature Sensor and a CT2000 Miniaturized Ambulatory Recorder (HTI Technologies, Inc, Palmetto, FL). Sweat loss was determined as the change in BM from pre-exercise to immediate post exercise measured using a standard electronic scale. HR was monitored using a Polar T34 chest transmitter (Polar Electro, Inc, Lake Success, NY) which wirelessly transmits the heart rate data to a Polar WearLink compatible receiver. Results: ANOVA with repeated measures revealed a significant Time main effect (F6,48 = 63.51, p = .001) for Tcore, as a progressive increase was observed throughout the exercise protocol. Cshirt had no effect however, as a significant Condition x Time interaction (F4,48 = 1.40, p = .235) was not observed. A significant Time main effect (F1,11 = 201.97, p = .001) was also observed for BM, as a significant decrease was observed. The Cshirt did effect sweat loss, as a significant Condition x Time interaction (F1,11 = 4.88, p =.044) was observed. Tshirt resulted in a significant decrease in BM from pre $(83.4 \pm 9.5 \text{ kg})$ to post $(82.7 \pm 9.4 \text{ kg})$ exercise, while no change was observed when comparing the pre (83.1 ± 9.5) kg) to post (82.8 ± 9.5 kg) Cshirt BM. Conclusions: The CoolShirt SystemTM enabled subjects to maintain a similar Tcore while sweating less. This might aid the body's thermoregulation when exercising in the heat.