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Young Men And Women And Fire: Field Use Of Doubly Labeled Water During Arduous Work In The Wildland Firefighter.

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Introduction: The wildland firefighter is exposed to a number of unique occupational stressors that include extended work hours, sleep deprivation, dietary limitations, and heat stress. The purpose of this topic review is to discuss the nature of the doubly labeled water (DLW) methodology during an unpredictable field situation in male and female wildland firefighters. Of interest to our laboratory was the application of the DLW methodology (often limited to the laboratory/clinical environment or during simulated exposures) to an arduous, unpredictable environment. **Methodology:** Seventeen wildland firefighters were recruited from three Interagency HotShot Crews (n=9 females, n=8 males) during the 1997 and 1998 fire seasons. During these fire seasons, subjects were studied on one of five wildfires (MT, CA, FL, WA, and ID). Upon arrival at the wildfire incident and prior to wildland fire suppression, and after the collection of a background urine sample, each subject was given an oral dose of ^2H_2O and $H_2{}^{18}O$ (approximately .23g ^2H_2O/kg TBW, .39g $H_2{}^{18}O$/kg TBW) at approximately 2200. Urine samples were collected from first void and second void the following morning (approximately 0430—0500) along with a nude body weight (±100 g). First void urine samples were collected daily throughout the measurement period. Upon consultation with the Incident Commander, the time frame for each measurement period was determined (5-7 days). At the end of the measurement period, subjects were provided with approximately 2 g ^2H_2O at approximately 2200 for an end measure of total body water. Samples were analyzed as previously discussed by Schoeller (1-4). Rates of total body water turnover were calculated from the established TBW (from back extrapolation to the timing of the original dose, the elimination rate of ^2H and an adjusted fractionation factor). TEE (kcals/24 hr) was calculated from a modified Weir equation using the calculated RQ from dietary intake records (5) using a three-point linear elimination equation. Further, rates of evaporative water loss (rH_2O) were calculated from D_2O elimination, during the measurement period to evaluate the hydration requirements of the job. **Results/Discussion:** The TEE of the wildland firefighter is likely to vary dependent on work shift length, job duties (fire line construction, saw work, hiking), and terrain. Although the DLW methodology does not allow for the estimation of TEE on a day to day basis, our results indicate a rigorous occupational environment for both sexes. The DLW methodology can accommodate short experimental periods due to rapid rates of evaporative water loss. However, the limitations for un-simulated field experiments will be discussed (timing of isotopic dose, factors affecting isotope elimination and calculations). These results demonstrate an extreme occupational stress and represent a unique physiological challenge to the maintenance of energy balance and normal hydration in the human. **References:** **1)** Schoeller DA, Ravussin E, Schutz Y et al (1986). Energy expenditure by doubly labeled water: validation in humans and proposed calculation. **Am J Physiol** 250:R823-830. **2)** Schoeller DA (1996). Hydrometry, **In: Human Body Composition: Methods and Findings** ed. Roche AF, Hymsfield S, Lohman T, Human Kinetics Pub, Champaign, IL pp25-44. **3)** Schoeller DA and Hnilicka J (1996). Reliability of the doubly labeled water method for measurement of total daily energy expenditure in free-living subjects. **J Nutr** 126:348S-354S. **4)** Schoeller DA and Luke AH (1997). Rapid 18O analysis of CO2 samples by continuous flow isotope ratio mass spectrometry. **J Mass Spectrom** 32:1332-1336. **5)** Weir, JB de V. (1949) New methods for calculating metabolic rate with special reference to protein metabolism. **J Physiol 109:1-9**.

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