Changes in Urine Specific Gravity and Bioelectrical Impedance Analysis between Normal-Hydrated and Euthyroided States

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ABSTRACT:
BACKGROUND: Urine specific gravity (USG) is a simple way to estimate the hydration of an individual that is directly proportional to urine osmolality. Bioelectrical impedance (BA) is used to estimate hydration status and body composition accurately.

PURPOSE: Our study measured the effects of extra water consumption on USG and BA.

METHODS: We predicted that extra water consumption would increase USG and decrease BA by 1.0–2.0% in those who were not severely dehydrated. Nine college-aged men participated in the study. Each participant was given an extra 500 mL of water and measured USG and BA 1 h before and after the water intake.

RESULTS: All participants showed a decrease in USG and an increase in BA 1 h after the water intake.

CONCLUSIONS: USG was affected by extra water consumption, but not BA.

INTRODUCTION & HYPOTHESES:
Urine specific gravity (USG) is a simple way to estimate hydration status of an individual. It is directly proportional to urine osmolality. Osmolality measures solute concentration, which includes protein like creatinine, glucose, hormones, or ions. Two classic forms of measuring USG are by a refractometer or by a dipstick. The dipstick forms have widely been adopted as being unreliable (1, 2). The National Collegiate Athletic Association (NCAA) uses USG as a hydration measurement in wrestlers to discourage athletes from using diuretic medications to decrease weight (2).

A normal specific gravity measurement should be between 1.002–1.035, with lower values indicating dehydration (dehydration) and higher values indicating potential dehydration. Any measurement above 1.035 should be considered abnormal, and may contain high amounts of solutes and should be restricted (3).

Bioelectrical impedance (BA) is a way to measure % body water, % body fat, and lean body mass in an individual. Electrodes are attached to the hands and feet of the body, and a small electrical current is sent through the body, and impedance is measured by the machine. Impedance is greatest in fat tissue, which contains only 10.20% water, while fat-free mass which contains 70.75% water, allows the signal to pass more easily. Some factors that may affect the BA analysis are dehydration, certain prescription drugs, caffeine, alcohol, and insulin. BA analysis is used frequently as a way to measure hydration status and body percentage accurately (4).

Our study measured the effects of extra water consumption on USG. We also looked at the effects of extra water consumption on the accuracy of the BA machine. We hypothesized that extra water consumption would decrease in urine specific gravity. We also hypothesized that extra water consumption would affect BA measurements significantly lowering % body water, increasing % body fat and increasing % lean body mass.

MATERIALS & METHODS:
All protocols employed in the study were approved by the IRB (IRB2008-0010). The subjects recruited for this study included 17 volunteers (10 females, 7 males) between 20-22 years of age (21.1 ± 0.94 yrs). Participants were instructed to stop drinking liquids 4 h prior to the first day of the study, and this would need to be replicated for the next day of the study.

Week 1: Analysis
Upon arriving at the lab, subjects were asked to provide a clean-catch urine sample, which involved the subject urinating for 5-10 seconds before collecting the sample. Samples were frozen until analysis. Subjects were randomly assigned to control or extra water groups for the next week of the study. Subjects who were assigned to the extra water group were instructed to drink an extra liter of neutral water during the 24 hours of daily replication.

Bioelectrical Impedance Analysis (BA):
Age, height, weight, dress, and waist circumferences were collected for all subjects and confidentially recorded on the right side of the body. All bioelectrical impedance was input into the BA machine. Two electrodes were placed below the left knee bone and the ankle bone connected on the right side as well. The electrodes were connected as described in the instruction protocol for the BodyToZ kit. Subjects who were dehydrated, the machine obtained body fat, lean mass (kg), body water (L), impedance (Ω), basal metabolic rate (BMR), body mass index (BMI) and recommended daily caloric intake (kcal).

Week 2: Analysis
Urine samples were collected at the beginning of the week following the protocol of Week 1. The samples from Week 1 and 2 were analyzed using the Lexicon TS400 refrigerator Rapid Chemical Analysis Instruments, Depuy NY, and the urine specific gravity values were recorded for both weeks.

BA Analysis:
Using the same measurements from Week 1 (new weights were recorded), BA analysis was performed. The same measurements were recorded.

RESULTS:
Urine Specific Gravity: No significant difference was found in USG in the control group from week 1 to week 2 despite a slight increase. USG significantly decreased from week 1 to week 2 in the extra water group (Figure 1).

Bioelectrical Impedance Analysis: The control group only showed statistically significant changes in weight and percent lean mass from week 1 to week 2 (Table 1). Weight increased from an average of 69.0 kg to 70.2 kg and percent lean mass decreased from an average of 19.9% to 18.1%. No significant differences were recorded for the extra water group in percent body fat (Figure 2), percent body water (Figure 3), percent lean mass (Figure 4), or daily caloric intake (Figure 5) from weeks 1 to 2.

REFERENCES:

DISCUSSION & CONCLUSIONS:
Our study concluded that urine specific gravity went down significantly when an extra liter of water was consumed within a 24 hour period. According to Popowicz et al., urine specific gravity and urine osmolality are sensitive to changes in hydration status. In our study, the athletes consuming extra water showed a decrease in USG, while the control group showed no change. This could be due to the athletes in the control group drinking less water or not drinking enough water to cause a significant decrease in USG.

Although our study showed that extra water consumption decreased USG, we did not observe any changes in BA measurements. This could be due to the fact that the athletes were not severely dehydrated, and therefore did not show any changes in their hydration status. However, further studies are needed to confirm these findings.

In conclusion, our study showed that extra water consumption can decrease USG and affect hydration status, but did not show any significant changes in BA measurements. Further research is needed to determine the effects of extra water consumption on both USG and BA measurements.