Context

Although some instruments have been validated for clinical measure of hydration status, new and currently invalid instruments are available for purchase and clinical use. Athletic trainers commonly use these instruments to assess hydration status for weight checks and body mass loss charts due to their ease of use. However, the validity of these popular instruments has not yet been established.

Purpose

To determine the validity of urine specific gravity (USG) for the assessment of hydration status via: handheld clinical refractometry, pen style digital refractometer, and midget urinometer as compared to the gold standard osmometer (OSMO).

Methods

Design: Descriptive diagnostic validity study

Setting: Biochemical research laboratory

Participants:
- Healthy active men and women
- n=108
- Age=22±4yrs
- Self reported
- Height=174±20cm
- Mass=75±17kg
- Recruited among faculty and students on a university campus

Inclusion criteria: Between the ages of 18-60, physically active.

Exclusion criteria: Chronic urinary tract infection, diabetes, or kidney disease

Independent Variable:
- Instrument Type:
  - Digital refractometer (DR)
  - Clinical refractometer (CR)
  - Urinometer (UR)
  - Osmometer (OSM)

Dependent Variable:
- Hydration Status:
  - Urine specific gravity (USG)
  - Osmolality (OSMO)

Intervention:

Procedures:
- Completion of informed consent and health history questionnaire
- Provided a standard clean urine sample cup(s)
- Instructed to proceed to the nearest restroom and provide a sample(s)
- Hydration assessment was performed within 2 hours
- Prior to each data collection, each instrument was calibrated
  - Digital Refractometer: tip placed in distilled water and auto calibrated so that the screen displayed only 1.0000.
  - Clinical Refractometer: distilled water was placed on the viewing plate and scale was adjusted until it displayed 1.000.
  - Urinometer: The stand was filled with distilled water and the shot ballast was placed into the fluid so that it read 1.000.
  - Osmometer: Calibration was performed according to manufacturers' instructions with known calibration standards prior to each session and as needed.
- During each collection session, new transfer pipettes and osmometer tips were used in order to decrease the risk of contamination between samples

Statistical Analysis:
- Pearson’s product correlations for each USG instrument and OSMO
- Z scores were calculated for standardized comparisons
- Alpha set at ≤0.05 a-priori

Results

DR (r=0.814, p<0.001)
CR (r=0.943, p<0.001)
UR (r=0.133, p<0.142)

Conclusions

- Handheld clinical refractometry can be used confidently for assessing hydration status as it shows a strong significant correlation with the gold standard osmometer, which is consistent with previous literature.
- Additionally, the use of the pen style digital refractometer showed a strong, significant correlation with the gold standard osmometer and provides clinicians with another option for the clinical assessment of USG and hydration status.
- The findings of this also study suggest that the use of a midget urinometer should be discouraged, as it showed a weak correlation with the gold standard osmometer, indicating it might not provide accurate results when used to determine hydration status.
- The information from this study will help generate clear recommendations for instrumentation usage during hydration testing for organization such as the NCAA, NATA, ACSM, and NWCA.

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