

# Examining the WUT (Body Weight, Urine Color, and Thirst Perception) Venn Diagram Compared to 24-HR Hydration

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## Introduction

- The WUT (body weight, urine color, thirst perception) Venn diagram has been recommended as a field tool for hydration assessment (1).
- Few studies have examined the clinical utility of this self-hydration assessment (4, 5).
- Sex differences in hydration assessment using the WUT Venn diagram have limited data (2, 3).
- No investigations have examined whether there is a difference in the accuracy of self-assessed and lab-assessed WUT scores.

## Purpose

To examine the validity and explore potential sex differences in the accuracy of the WUT Venn diagram for hydration status determination. A secondary aim of the study was to investigate the accuracy of self-assessed WUT scores and lab-based WUT scores for hydration.

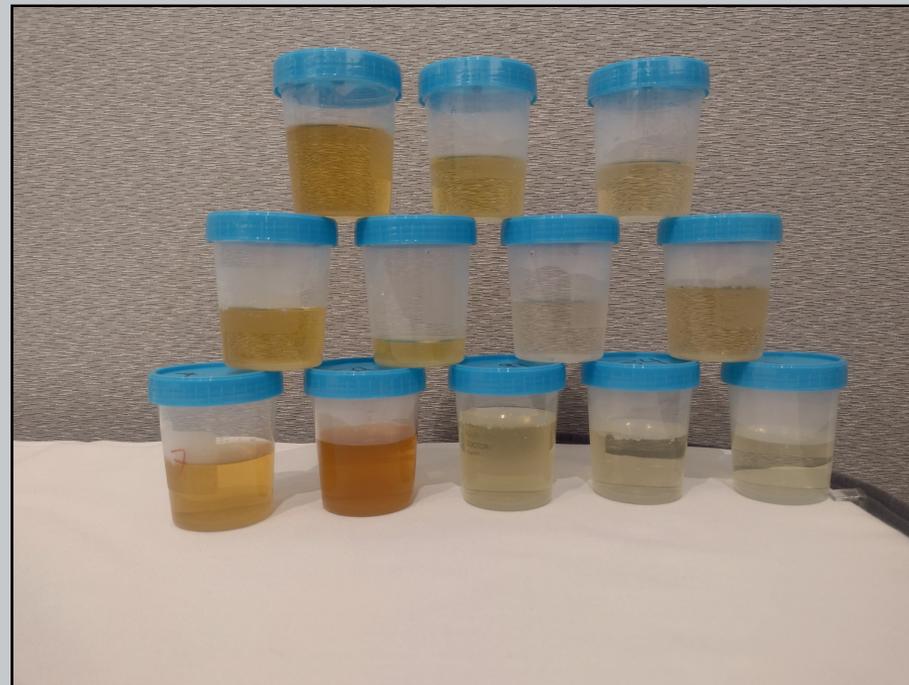
## Methods

- Participants collected urine on the first morning, afternoon, and during 24 hours on three out of seven consecutive days.
- Body mass, urine color ( $U_{col}$ ), urine osmolality ( $U_{osm}$ ), and thirst perception were measured or recorded for first morning and afternoon samples in free-living conditions.
- $U_{col}$  and  $U_{osm}$  were assessed for 24-hour samples.
- Clinical statistics analysis calculated the sensitivity and specificity of 0, 1, 2, or 3 WUT scores. Receiver-operating characteristics analysis calculated the sensitivity and specificity of 0, 1, 2, or 3 WUT markers in detecting hypohydration or euhydration.
- The 24-hr  $U_{osm}$  cutoff for euhydration was  $< 500$  mOsm/L. The thirst level cutoff was  $< 2$ .

## References

1. Armstrong, LE. Assessing hydration status: The elusive gold standard. *J Am Coll Nutr* 26: 575s-584s, 2007.
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Overall, the diagnostic utility of the measure for predicting 24-hour urine osmolality ( $U_{osm}$ ) was limited.



Sensitivity ranged from 0.37 to 0.67, specificity from 0.00 to 0.85, and positive likelihood ratios (LR<sup>+</sup>) from 0.67 to 2.60, indicating low to moderate accuracy and poor discriminative capacity.

## Results

Table 1. Anthropometric and descriptive data for male and female participants.

Sex	Age (yr)	Body Weight Average (kg)
Male	22 ± 4	81.9 ± 15.3
Female	26 ± 7	74.8 ± 16.3

All values are listed in mean ± standard deviation.

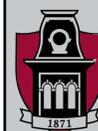
- Females' self-reported urine color ( $4 \pm 1$ ) was significantly lower than males' ( $5 \pm 1$ ;  $p = 0.04$ ).
- Females'  $U_{osm}$  ( $471.5 \pm 51.7$  mOsm/L) tended to have a decreased 24-hr osmolality compared to males ( $622.1 \pm 57.8$  mOsm/L;  $p = 0.07$ ).
- There were no sex differences ( $p = 0.169$ ) or significant time point differences for  $U_{osm}$  for spot urine ( $p > 0.184$ ).
- The first morning ( $p < 0.001$ ) and afternoon ( $p = 0.032$ ) WUT scores were significantly greater when self-rated compared to lab-rated WUT scores. Morning ( $r = 0.571$ ;  $p < 0.001$ ) and afternoon ( $r = 0.715$ ;  $p < 0.001$ ) WUT scores were significantly correlated between lab and self-ratings.
- Afternoon ( $r = 0.568$ ;  $p < 0.001$ ) WUT scores were significantly correlated with 24-hr  $U_{osm}$  values, but first morning measures were not ( $r = 0.059$ ;  $p = 0.673$ ).
- Overall, sensitivity (Sn: 0.37 - 0.67), specificity (Sp: 0 - 0.85), and LR<sup>+</sup> (LR<sup>+</sup>: 0.667 - 2.60) ranges demonstrated limited ability to predict 24-hr  $U_{osm}$ .

## Conclusion

- The evaluated test demonstrated limited predictive value for 24-hour  $U_{osm}$ . The variability and generally low ranges in sensitivity, specificity, and LR<sup>+</sup> suggest it is not a reliable standalone indicator of hydration status based on urine concentration.
- When self-rating WUT scores were significantly higher than lab-based WUT scores.
- Females' self-reported urine color was significantly lower than that of males.
- Further research is needed to identify the differences between lab-based and self-assessed WUT hydration, as well as the clinical validity and reliability of the WUT Venn diagram for self-identification of hydration status.

## Practical Application

In field settings (athletics, occupational, and military operations), the utility of the WUT Venn diagram should be used with caution if used to reflect overall hydration status (5).



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