Utility of First-Morning Urine and Plasma Copeptin to Reflect 24-Hour Hydration Behaviors

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INTRODUCTION

The high-value and minimally invasive assessment of hydration practices in informing individuals' health outcomes and practically addressing community health challenges has gained increasing attention. Determining the corresponding emerging health risk profiles linked to hydration practices demands simple, low-cost, accurate, and readily scalable hydration monitoring. First morning, as opposed to a 24h urine sample, is largely far less adulterated by dietary solute load, recent exercise, or heat exposure, making it an appealing single-sample suitable measure for hydration assessment. However, first morning urine (FMU) is compositionally different from other spot sample timings due to overnight water conservation and no or limited recent intake of food or water. These latter factors thus limit the utility and adoption of other urine sample timings using traditional criteria for denoting hydration status.

We recently published on the utility of first morning urine osmolality (FMU_Osm) and specific gravity (FMU_SG) in representing one's typical (previous 24h and 5d) hydration practices in a non-dietary controlled, observational setting with corresponding criteria for hydration assessment. Here we aim to replicate the former study's findings regarding characterizing one's prior 24h hydration profile for validation in a controlled interventional study. We further seek to determine the definitive utility of plasma copeptin (pCop), a desirable surrogate for arginine vasopressin (AVP) and a more stable biomarker, in delineating hydration status. Plasma copeptin can also serve as a convenient indicator for selected aspects of hydration health risk.

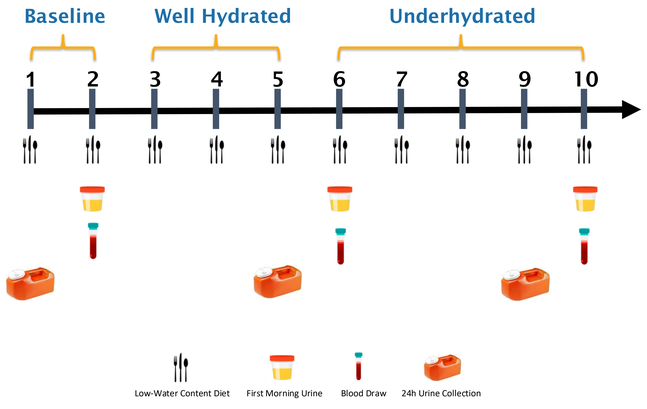
PURPOSE

We evaluated the diagnostic accuracy of FMU measures in indicating recent (previous 24h) hydration status, with a novel parallel examination of concurrent morning fasted plasma copeptin (pCop), during baseline hydration observation and subsequent intervention.

METHODS

Intervention Protocol:

- Participants: 22(4) years old men (n=14) and women (n=27)
- Participants replicated a low-water content diet throughout the study protocol
- Samples collected included 24-hour and first morning urine, and fasted morning blood
- Participants followed a hydration intervention as follows:
  - **Days 1&2: Baseline, Habitual hydration**
  - **Days 3-5: Well Hydrated (35ml·kg^{-1}·d^{-1})**
  - **Days 6-10: Underhydrated (20ml·kg^{-1}·d^{-1})**



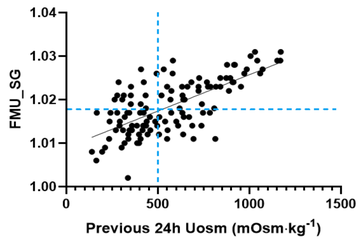
Statistics:

Receiver Operating Characteristic (ROC) Curve analysis was used to determine diagnostic accuracy and included:

- Area under the ROC curves (AUC)
- Sensitivity and specificity (%)
- Positive likelihood ratios
- Criterion values

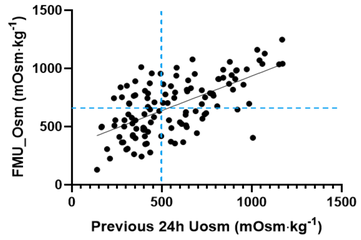
A previously reported 24h urine osmolality threshold of >500 mOsm·kg^{-1} was used to indicate underhydration.

RESULTS



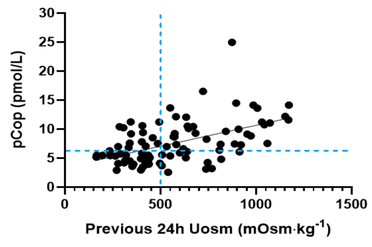
FM Specific Gravity

	AUC	Sensitivity	Specificity	+Likelihood Ratio	Criterion
Previous Study*	0.86	76.7	81.0	4.0	1.021
Current Study	0.80	71.4	75.4	2.9	1.018



FM Urine Osmolality

	AUC	Sensitivity	Specificity	+Likelihood Ratio	Criterion
Previous Study*	0.91	84.2	85.7	5.9	710
Current Study	0.78	71.4	70.7	2.4	673



Plasma Copeptin

	AUC	Sensitivity	Specificity	+Likelihood Ratio	Criterion
Current Study	0.75	73.9	68.2	2.3	6.31

*Previous Study: Muñoz, C. X., & Bergeron, M. F. (2023). Characterizing Hydration Practices in Healthy Young Recreationally Active Adults-Is There Utility in First Morning Urine Sampling?. International journal of sport nutrition and exercise metabolism, 33(5), 265-274. https://doi.org/10.1123/ijsnem.2022-0203

CONCLUSIONS

These data underpin the acceptable diagnostic accuracy of FMU_SG and FMU_Osm in conveniently indicating hydration status during the previous 24h. Whereas FMU_SG had the highest diagnostic accuracy based on AUC, FMU_Osm and pCop nonetheless provided sufficient accuracy to be considered in future studies as potential diagnostic tools for profiling hydration. Growing evidence for chronic elevated pCop in disease etiology and outcome prediction implies high value in solidifying pCop concentration as indicative of hydration status and corresponding health concerns. Thus, FMU assessments aptly align with effectively tracking pCop health criteria for monitoring and optimizing hydration health.

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