UNIVERSITY OF HARTFORD
COLLEGE OF EDUCATION, NURSING AND HEALTH PROFESSIONS

Utility Of First Morning Urine Sampling To Indicate Previous 24h And 5d Hydration Practices

Colleen X. Muñoz[1] – Alexis M. Acosta[1] – Asha Farquhar[1] – Isaiah L. Coleman[1] – Julia C. Cook[1] – Kelly Chen-Ruan[1] – Stivens Mejia-Cornelio[1] – Michael F. Bergeron FACSM[2]

[1]University of Hartford, West Hartford, CT, USA – [2]SIVOTEC Analytics, Boca Raton, FL, USA

ABSTRACT

Establishing suitable evidence aligning hydration practices and health outcomes demands simplicity, low cost, and accurate hydration monitoring. First morning urine (FMU) assessment may be a practical solution. **PURPOSE:** Determine the strength of FMU as a valid indicator of recent (previous 24h and 5d average) hydration practices that would otherwise be denoted by 5d dietary intake, 24h urine, and morning circulating copeptin. **METHODS:** For 5 consecutive days, 67 healthy men (n = 29) and women (n = 38) (age: 20 ± 1y, BMI: 25.9 ± 5.5) completed 24h diet logs, 24h urine collection, FMU collection (last day only), and morning blood sampling. Diet logs were analyzed for total water intake (TWI; from beverages and foods) relative to body mass, urine was measured for osmolality (Uosm) and specific gravity (Usg), and blood was measured for plasma copeptin (Pcop). Pearson correlations were evaluated for significance and relationship strength amongst FMU and all other variables. Area under the Receiver Operating Characteristic curves (AUC) and positive likelihood ratios (+LR) were employed to indicate underhydration (TWI <30 ml·kg^{-1}, Uosm >800 mOsm·kg^{-1}, Usg >1.017, and Pcop >6.93 pmol·L^{-1}). **RESULTS:** FMUosm and FMUsg (statistics presented in respective order; p < 0.05 unless noted) were significantly correlated with 24h TWI (r = -0.44 and -0.42), 5d TWI (r = -0.52 and -0.50), 24h Uosm (r = 0.76 and 0.68), 5d Uosm (r = 0.71 and 0.67), 24h Usg (r = 0.49 and 0.42), 5d Usg (r = 0.67 and 0.63), and concurrent morning's Pcop (r = 0.26 and 0.26; FMUosm p = 0.054) but not 5d Pcop. Of those variables, FMUosm had the greatest utility (AUC > 70%; sensitivity and specificity > 80%) in indicating 5d Uosm (FMUosm criterion >885.8 and +LR = 4.4). Diagnostic accuracy using FMU was generally greater for previous 5d than 24h hydration indicators, except for Pcop. **CONCLUSION:** These data support previous claims that FMU sampling better represents chronic than acute hydration practices. Further, FMUosm has slightly greater utility than FMUsg in recent hydration history assessment. With less effort and cost restriction, FMU is a viable metric to assess routine hydration practices for mitigating related risk of chronic illness.

INTRODUCTION

Establishing suitable evidence aligning hydration practices and health outcomes demands simplicity, low cost, and accurate hydration monitoring. First morning urine (FMU) assessment may be a practical solution due to ease in sampling compared to 24h urine collection and lack of dietary solute load interference.

PURPOSE

Determine the strength of FMU as a valid indicator of recent (previous 24h and 5d average) hydration practices that would otherwise be denoted by 5d dietary intake, 24h urine, and morning circulating copeptin.

METHODS

Sixty-seven healthy males (n=29) and females (n=38) (age = 20±1y, BMI = 25.9±5.5) participated in this observational investigation for 5 consecutive days.

METHODS (cont.)
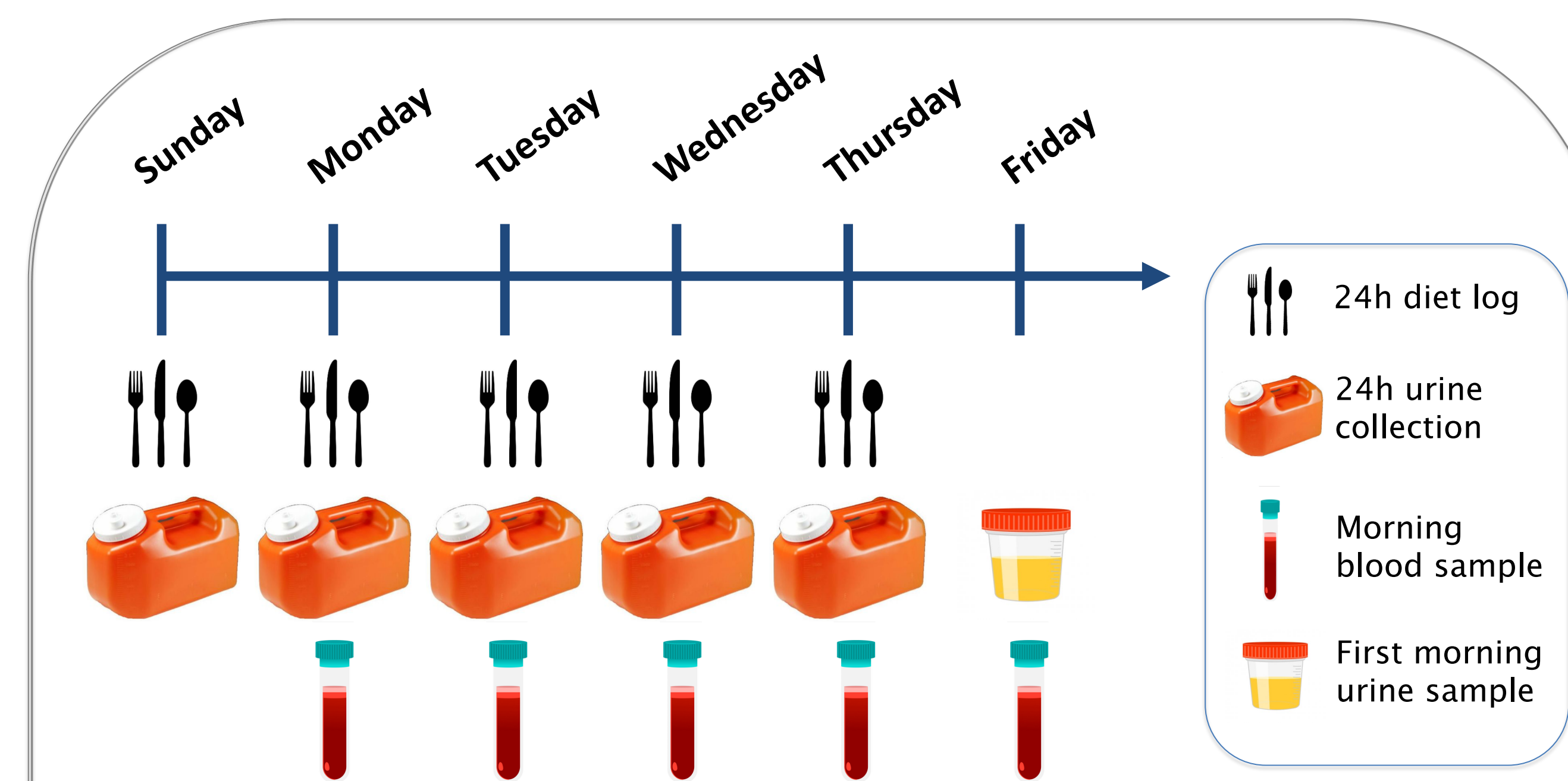
Data derived:
- **Total water intake relative to body mass (TWI)**
- **Urine osmolality (Uosm)**
- **Urine specific gravity (Usg)**
- **Fasted plasma copeptin (Pcop; via BRAHMS, KRYPTOR)**

Statistics:
- Pearson correlations were evaluated for significance and relationship strength amongst FMU and all other variables.
- Receiver Operating Characteristic (ROC) Curve
  - Area under the ROC curves (AUC)
  - Sensitivity (SN) and specificity (SP) (%)
  - Positive likelihood ratios (+LR)

Previously reported values were used to indicate underhydration (TWI <30 ml·kg^{-1}, Uosm >800 mOsm·kg^{-1}, Usg >1.017, and Pcop >6.93 pmol·L^{-1}).

RESULTS

FMUosm - Pearson Correlation

	24h TWI	5d TWI	24h Uosm	5d Uosm	24h Usg	5d Usg	Concurrent morning Pcop
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.054
r	-0.44	-0.52	0.76	0.71	0.49	0.67	0.26

FMUsg - Pearson Correlation

	24h TWI	5d TWI	24h Uosm	5d Uosm	24h Usg	5d Usg	Concurrent morning Pcop
p	< 0.001	< 0.001	< 0.001	< 0.001	0.001	< 0.001	0.038
r	-0.42	-0.50	0.68	0.67	0.42	0.63	0.26

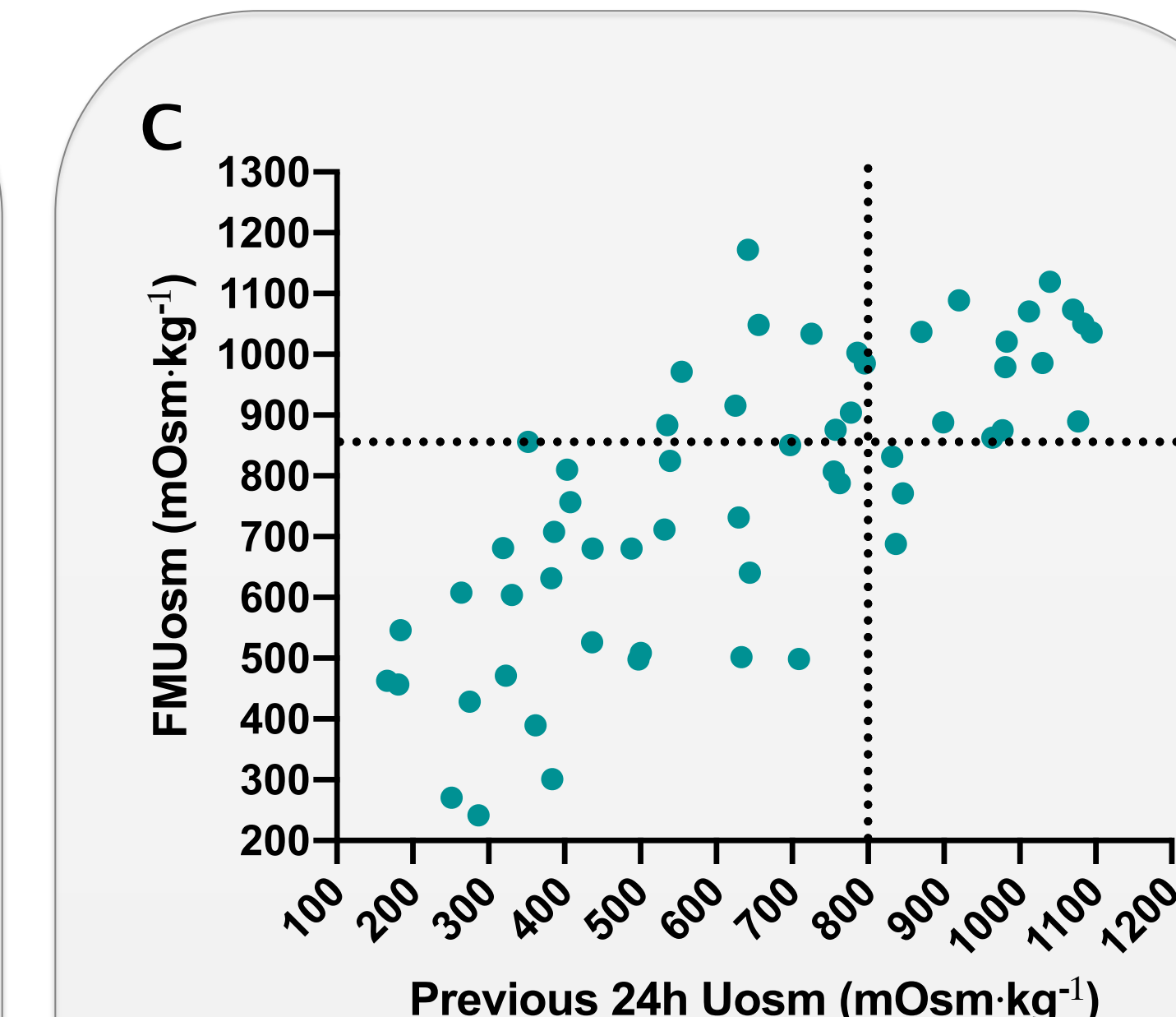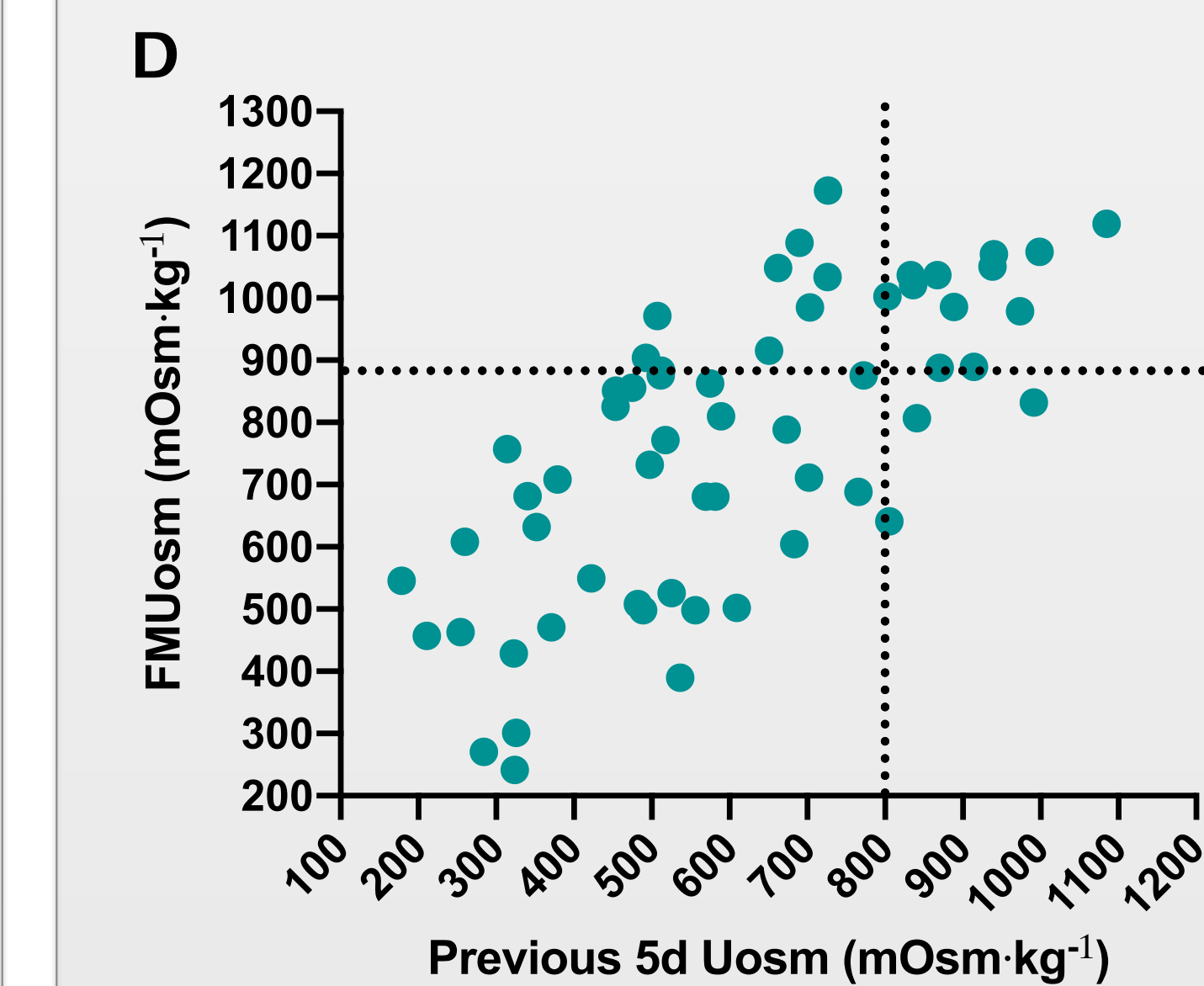*No significant relationship was detected between FMUosm or FMUsg and 5d Pcop.

RESULTS (cont.)
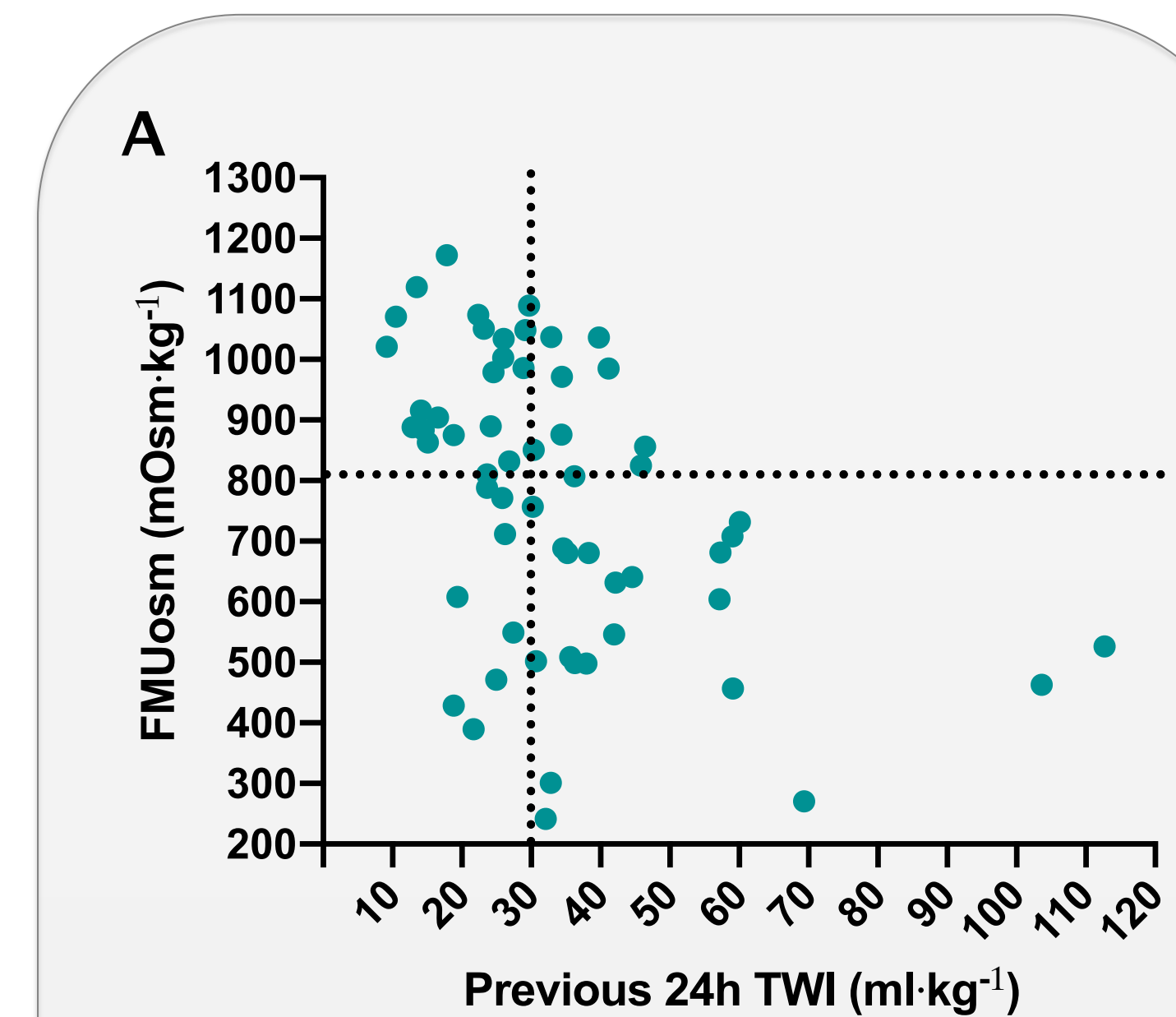
AUC	SN	SP	Criterion	+LR
0.77	72.4	73.3	808.5	2.7

AUC	SN	SP	Criterion	+LR
0.82	77.8	75.6	859.5	3.2
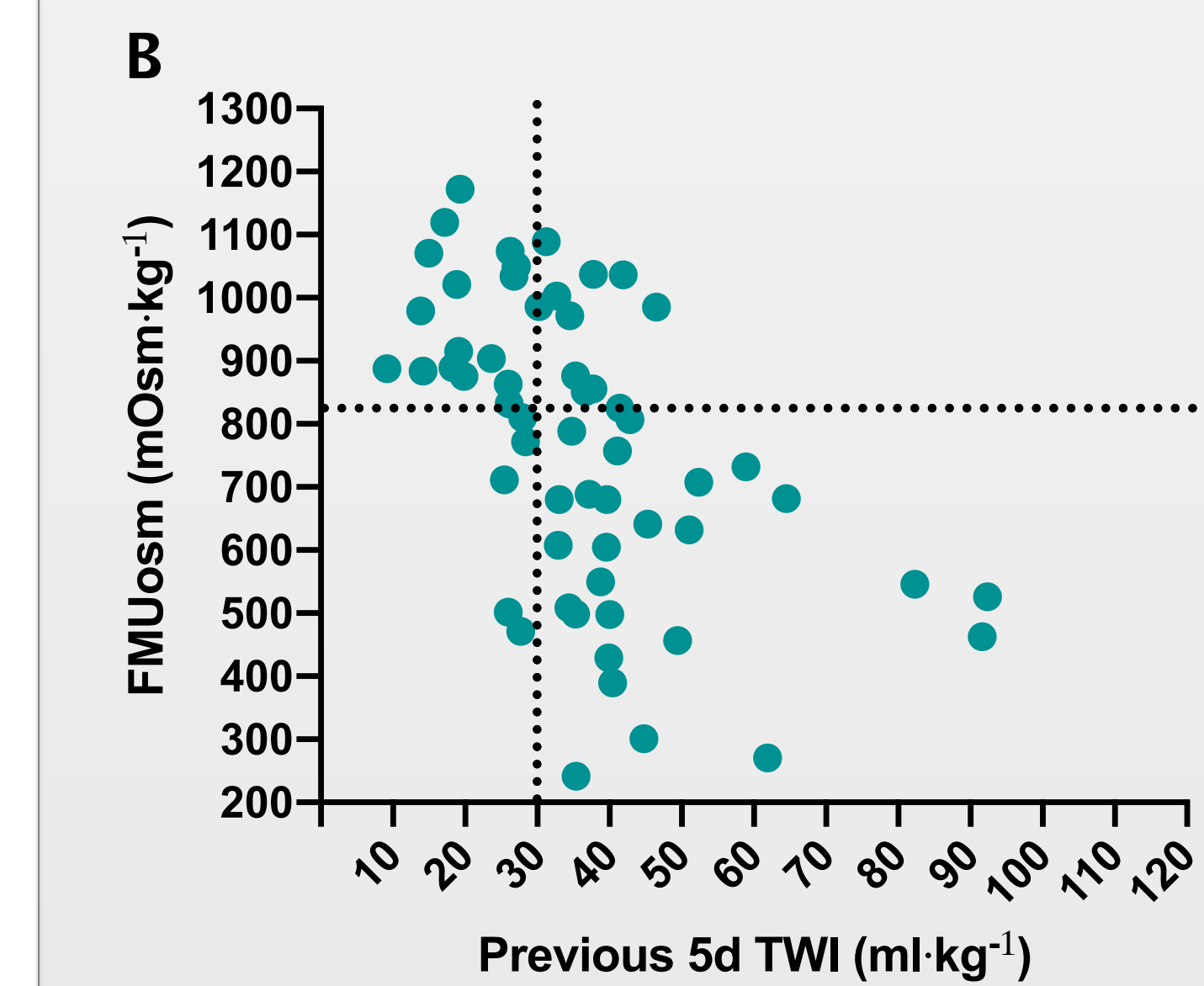
AUC	SN	SP	Criterion	+LR
0.79	77.3	73.0	828.5	2.9

AUC	SN	SP	Criterion	+LR
0.85	80.0	81.8	885.8	4.4

AUC	SN	SP	Criterion	+LR
0.82	76.5	72.3	1.023	2.8

Of the variables with the highest diagnostic accuracy (panels A-E), the ability of FMUosm to detect an average of 800 mOsm·kg^{-1} over the previous 5d (panel D) demonstrated the greatest utility evidenced by SN and SP greater than 80%.

Interpretation:
An individual with FMUosm of ≥886 mOsm·kg^{-1} is 4.4x more likely to have an average previous 5d Uosm of >800 mOsm·kg^{-1}.

CONCLUSION

These data support previous claims that FMU sampling better represents chronic than acute hydration practices. Further, FMUosm has slightly greater utility than FMUsg in recent hydration history assessment. Overall, diagnostic accuracy was greater for the previous 5d than the previous 24h hydration indicators, except for Pcop. With less effort and cost restriction, FMU is a viable metric to assess routine hydration practices for mitigating related risk of chronic illness.