

# Circadian variation and responsiveness of hydration biomarkers to changes in daily water intake

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## Introduction

Hydration biomarkers in 24h urine samples are widely used to assess dehydration, and their relevance in the evaluation of risk for various kidney and urinary tract pathologies has recently been highlighted. Unfortunately, collecting urine over 24 hours is both time-consuming and inconvenient. Moreover, it is not known how quickly hydration biomarkers in urine respond to changes in daily water intake. This is also true for hydration biomarkers in blood and saliva.

Shorter urine collections would reduce the time and effort required to obtain samples, and would make the daily monitoring of hydration easier for clinicians, health care professionals, and individuals. However, many biological measures follow circadian rhythms. Values may vary based on the time of day the sample is obtained. To-date, it is unclear whether short urine collections taken at different times of day can adequately represent the values seen in 24 hour samples.

Our aim was to assess the responsiveness of hydration biomarkers to a change in fluid intake, as well as to assess circadian variation. We measured a broad range of hydration biomarkers in urine, blood, and saliva in two groups of healthy adults, before and after a change in daily water intake volume.

## Key Findings

In healthy, sedentary adults, urinary biomarkers (osmolality, specific gravity, color, and volume) respond quickly to a change in water intake (within the first 24 hours). In contrast, blood and saliva osmolality did not respond to a change in water intake.

Urine concentration and volume were subject to circadian variation; values were different depending on the time of day the sample was obtained. The urine osmolality measured in samples taken in the afternoon (between 12:00-16:00 and 16:00-20:00) were the most closely matched to the 24h sample, falling within 50 mOsm/kg of the 24h value 75% and 87% of the time, respectively.

While saliva osmolality did not change in response to a change in fluid intake, it was temporarily affected early in the morning (higher) as well as in the hour following breakfast and lunch (lower).

## Relevance for Healthy Hydration

Recent papers have highlighted the links between fluid intake, urinary output, and disease risk: for instance, urinary volume and concentration may impact risk for chronic kidney disease as well as recurrence of kidney stones. Monitoring urinary hydration biomarkers may be an easy way for health care providers, patients, and the general public to ensure they are drinking enough water to promote sustainable health. Short, well-timed urine collections, particularly in the afternoon, may be a much more convenient alternative to 24 hour collections, providing an easy way to monitor daily hydration.

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