



Introduction

If you drink water, how and where does each water molecule travel through your body and how long does it stay there before it is excreted again? What role does the interstitium play in the human water handling and its related pathologies?

In urological practice it's often noticed that patients show a different response on (anti)diuretic medication, have a different diuresis rate, develop edema more easily, etc...

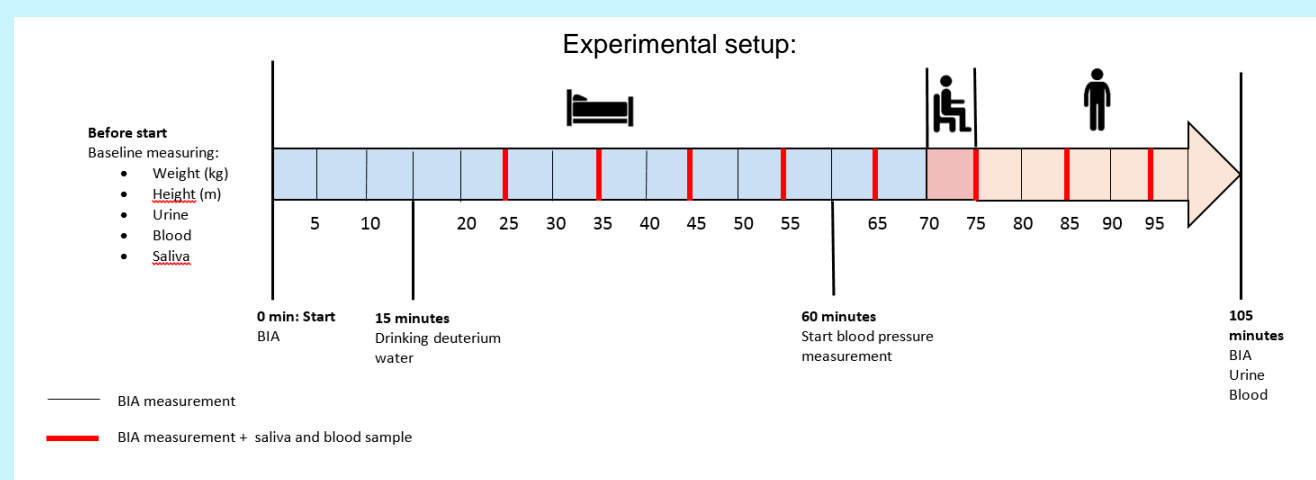
Till today we are not able to explain these differences.

The aim of this pilot study was threefold:

- Evaluate the relevance of using deuterium (heavy water) as a biological marker and bio-impedance analysis (BIA) to study the human water shift.
- Examine water handling in the interstitium of healthy volunteers
- Examine the impact of body position on the water shift between body parts.

METHODS

- Prospective interventional pilot study
- Between July 2018 and October 2018
- All participants were aged between 20 and 30 years and had a Body Mass Index (BMI) between 20 kg/m² and 24 kg/m².
- Volunteers with chronic diseases, implanted devices (pacemaker, IPG), on medication (except for anti-conception) and pregnant women were excluded.
- All tests started in the morning and volunteers had to be fasted.
- In total 19 volunteers were tested.



- Before starting the test protocol, a baseline urine-, blood- and saliva sample was collected.
- 15 minutes after the start of the test, participants drank 330 ml of deuterium (D) enriched water of which the deuterium-oxide volume was calculated as 0,25% of the individual's total body water (TBW) content.
- Bio-electrical impedance (BIA) measurement was done every 5 minutes.
- Saliva and serum samples were collected every 10 minutes, starting after the intake of the deuterium enriched water.
- At the end of the experiment a second urine sample was collected.



RESULTS

The bio-impedance (at 50 kHz) in the trunk was significantly different between the standing and the supine position, for both man and women (Friedman test; $p < 0.001$) (Fig. 1).

The D/H fraction in the blood, saliva and urine changed significantly over time. In man the maximum blood deuterium fraction was reached after ± 40 minutes while in women it increased almost linearly to a maximum after ± 80 min. (Friedman test; $p < 0.001$) (Fig. 2).

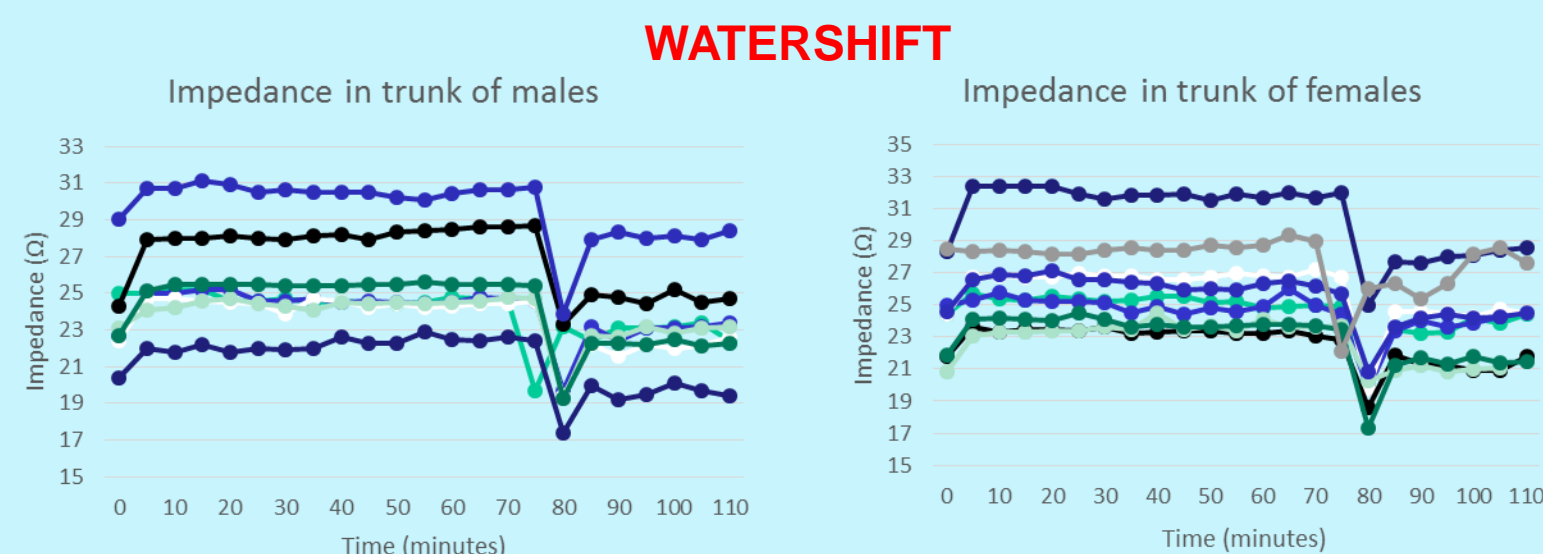


Fig 1: Bio impedance of the trunk of male and female volunteers, measured at 50 kHz. At time point 0 the persons changed from standing to supine position. After 70 minutes the person went from supine to sitting position and after 75 minutes the person went from sitting to standing position.

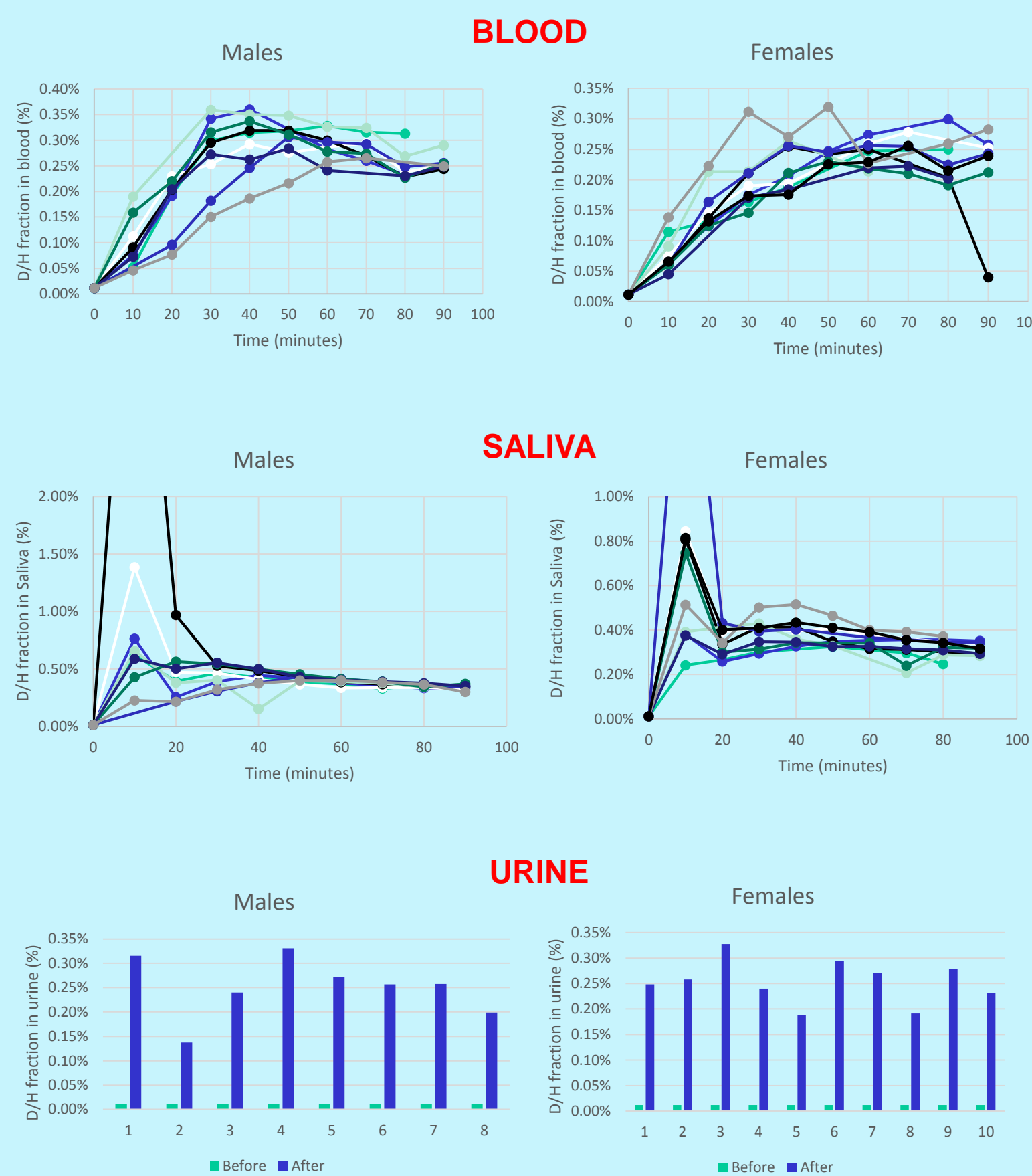


Fig 2: Deuterium/hydrogen fraction over time in the blood, saliva and urine of male and female volunteers.

CONCLUSIONS

- There is a clear water shift in the human body when people change their body position (supine, sit, stand).
- The results also suggest that there is a difference in water handling between man and women.
- Urine seems the perfect medium to estimate the D/H fraction in the total body water, better than blood.
- Water seems to be equally divided over the different water pools in the body but the speed differs between the different media and between genders.
- The interstitium seems to play a role in the human water shift, but this needs to be studied more thoroughly
- Bio-impedance and especially Deuterium proved to be a useful technique in urological research.

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