

Influence of sex, age, diet, and physical activity on hydration status and body composition of healthy individuals: cross-sectional study

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1. Introduction

Body hydration plays an important role in physiology and health. Dehydration, but also hyperhydration are important causes of ill-health, especially in the elderly.

Hydration depends on age, sex, and BMI, but also on nutrition and physical activity. However, little is known about the interaction of these determinants, and about the relative relevance. A better understanding of these interactions would facilitate a better prevention and more effective treatment alternatives of hydration related diseases.

The aim of the present study was to determine:

- The interaction of hydration determinants
- The relative relevance of the determinants
- Sex specific differences

2. Methods

We analysed 242 persons from the general population and of both sexes, age range 18-94.

Data on socioeconomics, demographics, nutrition, and physical activity was collected with a questionnaire.

Data on body composition, height and weight was collected with a bioelectric impedance analyzer (BIA) (Seca mBCA 515).

We measured total body fat mass (FM), visceral fat mass (VFM), fat free mass (FFM), skeletal muscle mass (SMM), total body water (TBW), intracellular water (ICW), extracellular water (ECW), and calculated the relative ratios.

Data was analyzed with multivariate linear regressions using STATA.

3. Results

We found significant sex differences in all body composition and hydration measures, except for total fat mass ($p > 0.05$).

ICW / FFM decreased with age in both sexes, ECW / FFM increased with age in both sexes.

For all regression analyses age, height, and body composition measures showed stronger associations with the hydration measures than diet and physical activity, see Figures 1 and 2 and Table 1 for all results.

In both sexes body height was associated with hydration ($p > 0.05$). The taller, the more ECW and the less ICW per FFM. This result remained if education was included in the analysis.

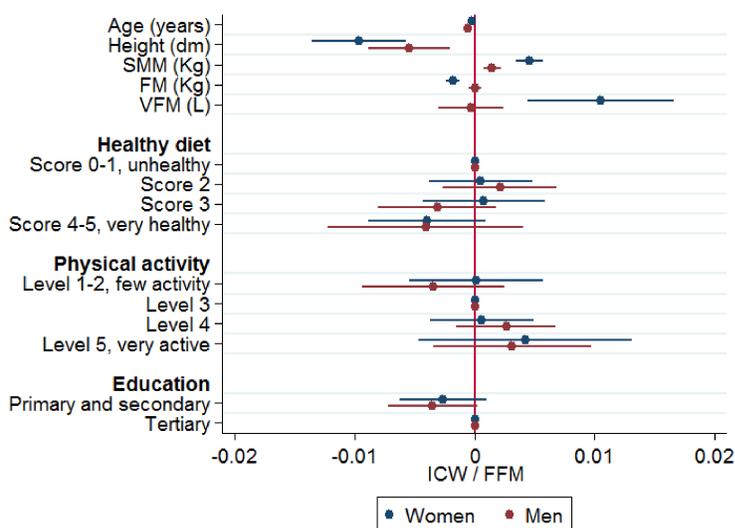


Figure 1: Associations to ICW/FFM, regression coefficients with 95% CI

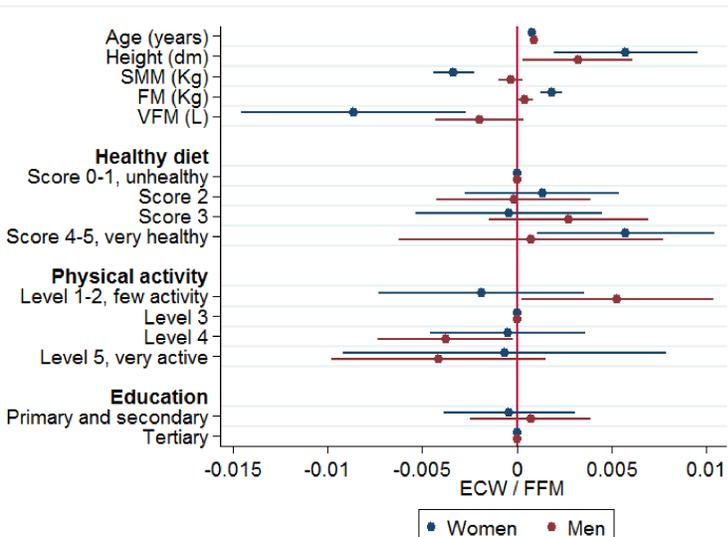


Figure 2: Associations to ECW/FFM, regression coefficients with 95% CI

4. Discussion

Sex and age are the most relevant determinants of body composition and hydration. Body composition is also an important determinant for hydration, but stronger in women than in men.

An explanation could be that at a similar BMI in both sexes women substantially have more fat than men and thus might have a different mode of regulation of the ECW. The extracellular compartment might therefore follow other mechanisms of compensation in women. This could lead to different risks of edema development or variable diseases of hydration in women and men, and a variable response to modulators.

Regarding the sex specific associations between hydration measures, nutrition and physical activity, further studies are needed to confirm the presented results, as the associations were only weak.

The associations between height and hydration are not intuitive and need further exploration.

Variable	Women		Men	
	t	p(t)	t	p(t)
Age	7.91	<0.001	10.98	<0.001
Height	3.91	<0.001	2.64	<0.05
SMM	-7.49	<0.001	-2.64	<0.05
FM	6.85	<0.001	1.19	>0.05
VFM	-3.34	<0.01	-1.02	>0.05
Healthy diet score				
0-1 (Ref), healthy				
2	0.19	>0.05	-0.46	>0.05
3	-0.13	>0.05	1.27	>0.05
4-5, unhealthy	2.08	<0.05	0.78	>0.05
Physical activity				
1-2, few activity	-0.43	>0.05	1.79	>0.05
3 (Ref)				
4	-0.08	>0.05	-1.58	>0.05
5, very active	-0.24	>0.05	-0.77	>0.05
Education				
1 primary and secondary	0.57	>0.05	1.43	>0.05
2 (Ref), tertiary				

Table 1: Associations with ECW / ICW, which is a measure for liquid shift between body departments and hence a sign for disease or inflammation. t indicates the strength and direction of the association.

Conclusions

- Body hydration seems to be differently regulated between the sexes and over the life course. This might be relevant for therapeutic or preventive measures.
- Lifestyle factors like nutrition and physical activity show a weak association with hydration, but this association differs between the sexes.
- The role of body height needs further exploration.