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Hypohydration and self-perceived exhaustion in older adults

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Hipohidratação e auto-perceção de exaustão em idosos

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Resumo

Enquadramento: A desidratação afeta a performance muscular mas a sua influência no estado de exaustão permanece pouco clara.

Objetivo: Quantificar a associação entre o estado de hidratação e a perceção do estado de exaustão em idosos.

Desenho do estudo: Estudo observacional transversal.

Amostra: Idosos portugueses (≥65 anos) participantes no estudo *Nutrition UP 65*.

Métodos: O estudo *Nutrition UP 65* incluiu uma amostra nacional representativa de idosos portugueses (≥65 anos) em termos de idade, sexo, escolaridade e região. Uma amostra da urina de 24 horas foi recolhida para estimar a reserva de água livre que foi categorizada em tercis de acordo com o sexo. Foram excluídos os participantes com urina de 24 horas incompleta e aqueles que reportaram doença renal. De uma amostra de 1500 participantes, 1143 foram incluídos no presente estudo. O estado de exaustão foi auto reportado e com base no *Center for Epidemiologic Studies Depression Scale* (CES-D). Foi elaborado um modelo de regressão logística binária para avaliar a associação entre a reserva de água livre e a exaustão. Os respetivos *Odds Ratio* (OR) e Intervalos de Confiança (IC 95%) foram calculados, por sexo e faixa etária.

Resultados: A mediana (intervalo interquartil) da reserve de água livre foi 0,52 (0,68) L nas mulheres e 0,36 (0,77) L nos homens. A hipohidratação afetou 11,6% das mulheres e 25,1% dos homens sendo que a exaustão foi reportada por 39,3% das mulheres e 25,1% dos homens. Após ajuste para potenciais confundidores, as mulheres com idade ≥80 anos no último terço de reserva de água livre revelaram uma diminuição do risco de perceção da exaustão [3º terço: OR=0,38; IC 95%: 0,15-

0,96], em comparação com as mulheres do 1º terço de reserva de água livre. Esta associação não foi observada em mulheres com menos de 80 anos nem nos homens.

Conclusão: Estes resultados revelam uma associação entre um pior estado de hidratação e a auto-perceção da exaustão em mulheres, evidenciando a necessidade para a implementação de futuros estudos para clarificar esta associação.

Palavras-Chave: estado de hidratação; reserva de água livre, idosos, estado de saúde.

Abstract

Background: Dehydration seems to affect muscle strength and weakness but its influence on exhaustion remains unclear.

Objective: To quantify the association between hydration status and perceived exhaustion among older adults.

Design: Cross-sectional observational study.

Subjects: Portuguese older adults (≥65 years old) participants in the Nutrition UP 65 study.

Methods: The Nutrition UP 65 study included a nationally representative sample of Portuguese older adults (≥65 years old) according to age, sex, education and region. A sample of 24h urine sample was collected to estimate free water reserve, which was categorized into tertiles according to sex. Subjects with incomplete 24-h urine and renal disease were excluded. From a sample size of 1500 subjects, 1143 were eligible for the present analysis. Exhaustion was self-reported according to the Center for Epidemiologic Studies Depression Scale (CES-D). A binary logistic regression model was conducted to evaluate the association between free water reserve and exhaustion. Odds Ratios (OR) and respective 95% Confidence Intervals (95%CI) were calculated, by sex and age group.

Results: Free water reserve median (interquartile range) was 0.52 (0.68) L in women and 0.36 (0.77) L in men. Hypohydration affected 11.6% women and 25.1% men whereas exhaustion was reported by 39.3% women and 25.1% men. After adjusting for potential confounders, women with ≥80 years old classified in the last third of free water reserve showed a decreased risk of perceived exhaustion [3rd third: OR=0.38;

95%CI: 0.15-0.96], compared to women in the 1st free water reserve third. No such significant association was observed in women with less than 80 years and in men.

Conclusion: These results show an association between a worst hydration status and self-reported exhaustion in older women, highlighting the need for implementing further studies to clarify this association.

Keywords: hydration status; exhaustion; free water reserve; older adults; health status.

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List of Abbreviations

NUTS II - Nomenclature of Territorial Units for Statistical Purposes

IPAQ - International Physical Activity Questionnaire

BMI - Body Mass Index

MNA®-SF - Mini-Nutritional Assessment® - Short-Form®

CES-D - Center for Epidemiologic Studies Depression Scale

FWR – Free Water Reserve

IQR – Interquartile Range

OR – Odds Ratio

CI – Confidence Intervals

FMUP - Faculty of Medicine of the University of Porto

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Introduction

Water is an essential nutrient for all functions of the human body representing 50-60% of total body mass [1, 2]. Along with other functions, water supports cellular homeostasis, transports nutrients and is a crucial component of thermoregulation [3]. There are large differences in the fluid intake and losses of individuals and the hydration status is not uniform across populations [4]. Water requirement depends on several factors such as renal solute load, climate and physical activity and a low intake of total water has been associated with a number of negative effects on health [1]. Dehydration - “the process of losing water and leads eventually to hypohydration (the condition of body water deficit)” [5, 6] – and even mild dehydration – defined as a 1-2% loss in body mass caused by fluid loss – affects overall health and increases various morbidities [1, 7].

The adequate total water intake for men is estimated to be 2.5 L/day and 2.0 L/day for woman [6] but the daily water supply of the older population is frequently lower than the recommended [8]. Older persons have a deficit in thirst and regulation of fluid intake – the thirst response is less effective due to changes in the activity of osmoreceptors and consequently a decrease in fluid intake [3, 6]. Also the loss of fluid may not be as well controlled, the fluid reserve is smaller and the kidney function decline so the ability to concentrate urine and retain fluids falls [5, 9]. Besides that dehydration risk can be exacerbated by the use of diuretics and a wide range of medications commonly used by older people [10]. These changes lead to an increased risk of hypohydration and some of the symptoms are connected to impaired functional status, physical performance and the development of several diseases [1, 11].

Muscle performance declines with ageing and a hypohydrated status seems to lead to a decrease in muscle strength [12] but how hydration status impacts exhaustion and wellness remains unclear [10]. Therefore, this study aimed to quantify the association between hydration status and perceived exhaustion among older adults.

Methods

Study design and sampling

This cross-sectional observational study was conducted in a sample of 1500 Portuguese subjects ≥65 years old between December 2015 and June 2016, according to “The Nutrition UP 65 Study Protocol” [13].

A nationally representative sample of Portuguese older adults was achieved in terms of sex, age, education level and regional area defined in the Nomenclature of Territorial Units for Statistical Purposes (NUTS II) [13]. The study sample was composed of 95% of community-dwelling older adults and of 5% by individuals institutionalized in retirement homes [13].

A random, stratified and clustered sampling method was applied. The potential participants were contacted by telephone, home approach or via institutions by interviewers who provided information about the study when invited them to participate. Individuals were considered eligible to participate if they had Portuguese nationality and if they were aged ≥65 years. Exclusion criteria were having any condition that precluded the collection of urine (eg. dementia or urinary incontinence).

Data collection and variable definition

Sociodemographic and lifestyle characteristics, clinical history, nutritional status and physical activity were collected using a structure questionnaire applied by trained interviewers.

Sociodemographic data included information on sex, age and marital status. To analyse marital status participants were grouped into two categories: single, divorced or widowed, and married or in a common-law marriage.

Lifestyle data included information on physical activity assessed by the short form of the International Physical Activity Questionnaire (IPAQ) [14]. Participants were classified as either presenting low physical activity levels, <383 kcal/week (men) and <270 kcal/week (women), or normal physical activity levels, ≥383 kcal/week (men) and ≥270 kcal/week (women) [14].

Clinical data included medication and supplements assessed by self-reporting. The health status was also self-reported and classified by participants as very good, good, moderate bad or very bad.

Body weight and standing height were assessed and Body Mass Index (BMI) was computed using the standard formula (body weight (kg)/standing height2 (m)). World Health Organization cut-offs were used to define underweight (<18.5 kg/m2), normal weight (18.5-24.9 kg/m2), overweight (25.0-29.9 kg/m2) and obesity (≥30.0 kg/m2). Only two participants were classified as underweight and therefore underweight and normal weight participants were grouped in one category. Undernutrition was assessed by the Portuguese version of the Mini-Nutritional Assessment® - Short-Form® (MNA®-SF) and participants were considered undernourished if the final score was ≤7 points and at risk of undernutrition if the final score was between 8 and 11 points. Participants with a score ≥12 points were classified without undernutrition risk/undernutrition [15].

Self-reported exhaustion was assessed using two items from the Center for Epidemiologic Studies Depression Scale (CES-D) [16]. The following two statements were read: (a) I felt that everything I did was an effort; (b) I could not get going. The question was asked “How often in the last week did you feel this way?” and was classified as 0 = rarely or none of the time (<1 day); 1 = some or little of the time (1-2 days); 2 = a moderate amount of the time (3-4 days); or 3 = most of the time (>4

days). The exhaustion criteria were considered present if the participant answered “2” or “3” to either of these questions [17].

A 24-hour urine sample was collected for each participant. The study interviewers gave the participants oral and written instructions detailing the collection and adequate storage procedures for the 24-hour urine volume. The following urinary markers were quantified by a certified laboratory: urine volume (mL), urinary creatinine (mg/day) and urine osmolality (mOsm/kg). Urinary creatinine was measured by the Jaffe method. A urine sample was considered inadequate if the creatinine level was <0.4 g/24-h for women and <0.6 g/24-h for men or if the volume collected was <500 mL [18, 19].

Hydration status was evaluated based on the concept of free water reserve (FWR) (mL/24 hours) calculated by subtracting 24-hour urine volume to obligatory urine volume (solutes in urine 24 hours [mOsm/day] / 830 – 3.4 x [age - 20]) [1, 20, 21]. The participant was considered as euhydrated if FWR was positive or hypohydrated/at hypohydration risk if FWR was negative [21].

Urine samples were also analysed for urinary sodium (milliequivalents/day); for comparative purposes, these values were converted to milligrams/day by using the molecular weight of sodium (23 milligrams sodium = 1 millimole sodium or 1 milliequivalents sodium). The amount of sodium ingested is considered to be the amount of sodium excreted.

Statistical analysis

Categorical variables were reported as frequencies. FWR was described as the median and interquartile range (IQR). Participants were compared across tertiles of FWR and exhaustion status for several socio-demographic, lifestyle, clinical and

nutritional characteristics using the Kruskal-Wallis test for continuous variables and Pearson qui-square test for categorical variables.

Binary logistic regression models were conducted to evaluate the association between perceived exhaustion and tertiles of FWR, adjusting for possible confounders. Odds Ratio (OR) and respective 95% Confidence Intervals (95% CI) were calculated. Results were considered significant when $p<0.05$. Statistical analyses were conducted using Statistical Package for Social Sciences for Windows (version 24.0, 2016, IBM-SPSS, Inc., Chicago, IL, USA).

Ethics

The study protocol was approved by the Ethics Committee of the Department of Social Sciences and Health from the Faculty of Medicine of the University of Porto (n° PCEDCSS – FMUP 15/2015) and by the Portuguese National Commission of Data Protection (nº 9427/2015) and was conducted according to the guidelines established by the Declaration of Helsinki. All participants were asked to read and to sign a duplicated *Informed Consent* form.

Results

The characteristics of the 1143 subjects across thirds of FWR and perceived exhaustion, according to sex are presented in Table 1 and 2. Of the 1500 participants recruited, 357 subjects were excluded because urine samples were considered incomplete or if they reported from kidney disease. Age ranged from 65 to 94 years old with a median (IQR) equal to 73 (10.0) years and women represented a higher proportion of the sample (55.7%).

FWR median (IQR) was 0.52 (0.68) L in women and 0.36 (0.77) L in men. Oldest women (≥80 years) presented lower median FWR compared to women with less than 80 years old (0.39 vs. 0.54, p=0.015) whereas no such difference was observed among men (0.43 vs. 0.34, p=0.092). Hypohydration affected 11.6% women and 25.1% men (p<0.001). Exhaustion was reported by 39.3% women and 25.1% men (p<0.001).

Higher proportions of women with a normal physical activity, with a very good or good self-perception of health status and without exhaustion were found in the highest FWR third (Table 1). Most women aged 65-79 years old, with a normal physical activity, without undernutrition, a very good/good self-perception of health status and in the last FWR third did not report exhaustion (Table 1).

In men, higher proportions of participants married or in a common-law marriage, with a normal physical activity, an inadequate salt consumption and without using diuretics were found in the first FWR third (Table 2). Most men with a normal physical activity, without undernutrition and a very good/good self-perception of health status did not report exhaustion (Table 2).

Significant differences according physical activity and self-perception of health status were found between thirds of FWR and reported exhaustion in both sexes. These variables were used in the multivariate analysis. Salt intake and diuretic use were also included as potential confounders for both sexes.

Women with ≥80 years old classified in the last third of FWR showed a decreased risk of perceived exhaustion [3rd third: OR=0.34; 95%CI: 0.15-0.79], compared to women in the first FWR third. This association remained statistically significant even after being adjusted for confounders [3rd third: OR=0.38; 95%CI: 0.15-0.96]. No such significant association was observed in women with less than 80 years neither in men (Table 3).

Table 1 – Socio-demographic, lifestyle, clinical, anthropometric and nutritional characteristics of 638 Portuguese older women (≥65 years old) according to FWR tertiles (L).

Participants' Characteristics	**1st Tertile,** <0.306 L **(n = 212)**	**2nd Tertile,** 0.306-0.768 L **(n = 214)**	**3rd Tertile,** >0.768 L **(n = 212)**	p	**With Exhaustion, (n = 251)**	**Without Exhaustion, (n = 387)**	p
Age, years, n (%)							
65-79	153 (72.2)	159 (74.3)	171 (80.7)		169 (67.3)	314 (81.1)	
≥ 80	59 (27.8)	55 (25.7)	41 (19.3)	0.105	82 (32.7)	73 (18.9)	<0.001
Marital Status, n (%)							
Single / divorced / widowed	127 (59.9)	129 (60.3)	132 (62.3)		163 (64.9)	225 (58.1)	
Married / common-law marriage	85 (40.1)	85 (39.7)	80 (37.7)	0.867	88 (35.1)	162 (41.9)	0.097
Physical Activity (IPAQ), kcal/week, n (%)							
Normal (men <383; women <270)	180 (84.9)	168 (78.5)	188 (88.7)		183 (72.9)	353 (91.2)	
Low (men ≥383; women ≥270)	32 (15.1)	46 (21.5)	24 (11.3)	0.015	68 (27.1)	34 (8.8)	<0.001
BMI, n (%)							
Underweight / normal	32 (15.1)	33 (15.4)	29 (13.7)		33 (13.1)	61 (15.8)	
Overweight	80 (37.7)	88 (41.1)	104 (49.1)		98 (39.0)	174 (45.0)	
Obesity	100 (47.2)	93 (43.5)	79 (37.3)	0.192	120 (47.8)	152 (39.3)	0.102
Nutritional Status (MNA®-SF), n (%)							
Without undernutrition	174 (82.1)	174 (81.3)	187 (88.2)		189 (75.3)	346 (89.4)	
With risk of undernutrition or undernourished	38 (17.9)	40 (18.7)	25 (11.8)	0.106	62 (24.7)	41 (10.6)	<0.001
Season Urine Sample Collection, n (%)							
Autumn / Winter	124 (58.5)	138 (64.5)	128 (60.4)		162 (64.5)	228 (58.9)	
Spring / Summer	88 (41.5)	76 (35.5)	84 (39.6)	0.430	89 (35.5)	159 (41.1)	0.159
Salt Consumption, g, n (%)							
Adequate (<5)	49 (23.1)	38 (17.8)	46 (21.7)		56 (22.3)	77 (19.9)	
Inadequate (≥5)	163 (76.9)	176 (82.2)	166 (78.3)	0.370	195 (77.7)	310 (80.1)	0.486
Diuretics use, n (%)							
Yes	33 (15.6)	33 (15.4)	41 (19.3)		42 (16.7)	65 (16.8)	
No	179 (84.4)	181 (84.6)	171 (80.7)	0.472	209 (83.3)	322 (83.2)	1.000
Self-Perception of Health Status, n (%)							
Very good / Good	64 (30.2)	46 (21.5)	67 (31.6)		38 (15.1)	139 (35.9)	
Reasonable	103 (48.6)	113 (52.8)	113 (53.3)		131 (52.2)	198 (51.2)	
Bad / Very bad	45 (21.2)	55 (25.7)	32 (15.1)	0.027	82 (32.7)	50 (12.9)	<0.001
Exhaustion, questions, n (%)							
Yes	87 (41.0)	95 (44.4)	69 (32.5)		-	-	-
No	125 (59.0)	119 (55.6)	143 (67.5)	0.036			
Free Water Reserve, liters, n (%)							
1st Tertil (<0.306)	-	-	-	-	87 (34.7)	125 (32.3)	
2nd Tertil (0.306-0.768)					95 (37.8)	119 (30.7)	
3rd Tertil (>0.768)					69 (27.5)	143 (37.0)	0.036

Table 2 – Socio-demographic, lifestyle, clinical, anthropometric and nutritional characteristics of 505 Portuguese older men (≥65 years old) according to FWR tertiles (L).

Participants' Characteristics	**1st Tertile,** <0,107 L **(n = 168)**	**2nd Tertile,** 0,107-0,626 **L (n = 169)**	**3rd Tertile**, >0,626 L **(n = 168)**	p	**With Exhaustion, (n = 127)**	**Without Exhaustion, (n = 378)**	p
Age, years, n (%)							
65-79	144 (85.7)	131 (77.5)	134 (79.8)		101 (79.5)	308 (81.5)	
≥ 80	24 (14.3)	38 (22.5)	34 (20.2)	0.140	26 (20.5)	70 (18.5)	0.695
Marital Status, n (%)							
Single / divorced / widowed	43 (25.6)	65 (38.5)	60 (35.7)		43 (33.9)	125 (33.1)	
Married / common-law marriage	125 (74.4)	104 (61.5)	108 (64.3)	0.031	84 (66.1)	253 (66.9)	0.913
Physical Activity (IPAQ), kcal/week, n (%)							
Normal (men <383; women <270)	156 (92.9)	136 (80.5)	146 (86.9)		97 (76.4)	341 (90.2)	
Low (men ≥383; women ≥270)	12 (7.1)	33 (19.5)	22 (13.1)	0.004	30 (23.6)	37 (9.8)	<0.001
BMI, n (%)							
Underweight / normal	26 (15.5)	32 (18.9)	33 (19.6)		19 (15.0)	71 (19.0)	
Overweight	80 (47.6)	90 (53.3)	94 (56.0)		60 (47.2)	204 (54.0)	
Obesity	62 (36.9)	47 (27.8)	41 (24.4)	0.146	48 (37.8)	102 (27.0)	0.066
Nutritional Status (MNA®-SF), n (%)							
Without undernutrition	149 (88.7)	153 (90.5)	149 (88.7)		105 (82.7)	346 (91.5)	
With risk of undernutrition or undernourished	19 (11.3)	16 (9.5)	19 (11.3)	0.819	22 (17.3)	32 (8.5)	0.008
Season Urine Sample Collection, n (%)							
Autumn / Winter	51 (30.4)	58 (34.3)	51 (30.4)		38 (29.9)	122 (32.3)	
Spring / Summer	117 (69.6)	111 (65.7)	117 (69.6)	0.665	89 (70.1)	256 (67.7)	0.660
Salt Consumption, g, n (%)							
Adequate (<5)	7 (4.2)	21 (12.4)	12 (7.1)		12 (9.4)	28 (7.4)	
Inadequate (≥5)	161 (95.8)	148 (87.6)	156 (92.9)	0.018	115 (90.6)	350 (92.6)	0.452
Diuretics use, n (%)							
Yes	9 (5.4)	21 (12.4)	26 (15.5)		15 (11.8)	41 (10.8)	
No	159 (94.6)	148 (87.6)	142 (84.5)	0.010	112 (88.2)	337 (89.2)	0.746
Self-Perception of Health Status, n (%)							
Very good / Good	77 (45.8)	67 (39.6)	63 (37.5)		34 (26.8)	173 (45.8)	
Reasonable	74 (44.0)	82 (48.5)	84 (50.0)		64 (50.4)	176 (46.6)	
Bad / Very bad	17 (10.1)	20 (11.8)	21 (12.5)	0.617	29 (22.8)	29 (7.7)	<0.001
Exhaustion, questions, n (%)							
Yes	38 (22.6)	49 (29.0)	40 (23.8)		-	-	-
No	130 (77.4)	120 (71.0)	128 (76.2)	0.357			
Free Water Reserve, liters, n (%)							
1st Tertil (<0.306)	-	-	-	-	38 (29.9)	130 (34.4)	
2nd Tertil (0.306-0.768)					49 (38.6)	120 (31.7)	
3rd Tertil (>0.768)					40 (31.5)	128 (33.9)	0.357

Table 3 – Binary logistic regression model results for the association between perceived exhaustion and FWR tertiles (L) and for 1143 Portuguese older adults (≥65 years old).

Free Water Reserve	65-79 years (n = 892)				≥80 years (n = 251)			
	Exhaustion				Exhaustion			
	Crude OR (95% IC)	**P trend**	Adjusted OR (95% IC)	**P trend**	Crude OR (95% IC)	**P trend**	Adjusted OR (95% IC)	**P trend**
Women (n = 638)								
1st Tertile (n = 212)	1		1		1		1	
2sd Tertile (n = 214)	1.14 (0.72-1.82)		1.09 (0.67-1.77)		1.29 (0.61-2.74)		1.07 (0.45-2.51)	
3rd Tertile (n = 212)	0.92 (0.58-1.46)	0.656	0.94 (0.58-1.52)	0.759	0.34 (0.15-0.79)	0.014	0.38 (0.15-0.96)	0.049
Men (n = 505)								
1st Tertile (n = 168)	1		1		1		1	
2sd Tertile (n = 169)	1.23 (0.71-2.11)		1.178 (0.67-2.08)		2.60 (0,73-9,22)		1.23 (0.27-5.58)	
3rd Tertile (n = 168)	0.97 (0.56-1.70)	0.901	0.875 (0.49-1.57)	0.625	1.80 (0,48-6,71)	0.551	1.11 (0.24-5.25)	0.960

*Variables used in both sexes: Physical activity (normal ≥270 or 383 kcal/week or low <270 or 383 kcal/week); Salt consumption (adequate or inadequate); Diuretics (no or unknown use); Self-perception of health status (Very good/Good or Reasonable or Bad/Very bad).

Discussion

This study provides the first reported evidence on the relation between hydration status and self-reported exhaustion among older adults and showed that better hydrated oldest old women have a decreased risk of perceived exhaustion.

Although the role of water and hydration in physical functions has been of considerable interest by the scientific community, the effect of water and hydration on psychomotor skills in older population stills unclear. One of the characteristics of the ageing process is the reduction of muscle strength, power and endurance. A recent study has demonstrated that hypohydration decreases muscle endurance by 8% and strength and aerobic power by 6% in younger adults [12]. Although data in older adults is scarce our study revealed that the participants who reported exhaustion showed to be less physically active which may be associated to difficulties at the muscle level. An appealing hypothesis to explain this relationship is that a worst hydration may alter neuromuscular functions and performance due to an impaired excitation-contraction coupling [22]. In the ageing muscle, a reduced homeostatic capacity for intracellular calcium movement has been demonstrated to reduce contractile dysfunction [23, 24]. This hypothesis led us to believe that hypohydration could be detrimental to muscle exercise capacity and exacerbate the effect of exhaustion in older adults. On the other hand muscle mass, which is rich stores of fluid, decreases with ageing and leads to a reduced fluid reserve [5].

In older adults mild dehydration has also been revealed to be a predictor of progressive deterioration of cognitive function [25] and the feeling of exhaustion can be a consequence of cognitive or psychological fatigue. It has been describe that hypohydration can influence cognitive status by producing disruptions in mood and

cognitive functioning such as concentration, alertness and short-term memory in older adults [26]. Scientific literature indicated that a progressive impairment in short-term memory and visual function was exhibited once 2% of body fluid deficit was achieved in healthy adults subjects [2]. It has been proposed that physiological acute stressors such as mild dehydration compete for attention and awareness with parallel processes occurring in other cognitive domains compromises overall cognitive performance [25]. Nevertheless, research on this hypothesis is limited.

In this study we can observe a gender difference in hydration status which is in accordance with other populations [20] and reflect a lower intake of water in men. Other differences between sexes may contribute to explain that the association between hydration and exhaustion was only found in women such as the fact that men are physically more active and have a better muscular performance. On the other hand, self-perceived health status - a predictor of physical and psychological functioning - declines with age and varies by gender: psychological exhaustion seems to be more frequent in women [27].

With ageing the total water intake seems to decrease [28]. A study from Volkert *et al.* (2005) showed that the oldest adults (≥85 years) had the lowest water intakes and consequently a worse hydration status [29] which is in line with our study. Thus, since hypohydration can influence self-perception of health status and cognition and the oldest women by rule reveal a greater physical and psychological exhaustion, a hypohydration status can indirectly enhance the feeling of exhaustion.

Although a single period of 24-h urine collection may not represent an individual´s normal behaviour it is considered the gold standard to assess urine concentration [30]. Specifically FWR is considered an useful marker to quantify individual 24-hour hydration status and identify subjects at risk of hypohydration [11]. It “corresponds to

the difference between the measure urine volume and the ideal urine volume necessary to excrete the actual 24-h urine solutes in subjects consuming a typical affluent Western type diet) [21]. In addition, having considered potential confounders as taking diuretics, consumption of salt, physical activity and self-perception of health status was crucial when studying the association between hydration status and exhaustion. This study was conducted with a sample of 1143 older adults and the possibility of type II error cannot be discarded. Also, the possibility that this sample can be biased towards a more responsive group of older adults cannot be ruled out once the recruitment methodology used did not allow us to calculate response rate and the reasons for refusal.

The importance of water to our health is crucial to understand how some morbidities can be associated to the hydration status. Several studies have shown a positive effect of increasing water intake on physical and cognitive functioning which emphasizes the role of hydration in an exhaustion status. Even though causality cannot be established, this study highlights the need to deepen the research on the association of hydration status and physical and cognitive function and perceived exhaustion among older persons. Preventing exhaustion involves providing a good hydration status aiming an adequate fluid intake and the development of ways of screening to encourage older people and their caregivers know how to achieve and sustain an adequate hydration status.

Conclusion

These results showed an association between a worst hydration status and self-reported exhaustion in the oldest women, highlighting the need for implementing further studies to clarify this association.

Key Points

- First reported evidence that a better hydration was protective against perceived exhaustion in the oldest women.
- In this study 11.6% of women and 25.1% of men were considered hypohydrated.
- The prevalence of exhaustion was 39.3% in women and 25.1% in men.

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