Hydration Status, Body Composition and Anxiety Status in Aeronautical Military Personnel from Spain: a cross-sectional study

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Abstract

Background: An adequate hydration status is critical to ensure efficiency during mental and physical activities. Our goal was to assess the hydration status of a Spanish group of aeronautical military men and to determine the association of hydration status with body composition and anxiety.

Methods: 188 men were evaluated through a validated hydration questionnaire, anthropometric and biochemical parameters, and an anxiety questionnaire. According to that, criteria of hydration was established.

Results: 81% of the total sample met hydration criteria (urine color = Well hydrated, Water Balance ≥ 0 mL, and total water intake/weight ≥35 mL/kg) and 19% did not meet hydration criteria (urine color = Not enough hydrated or Dehydrated, Water Balance < 0 mL, and total water intake/weight < 35 mL/kg). Subjects not meeting the hydration criteria had lower urine pH, negative water balance, and lower water intake. The latter also had higher anxiety status (score= 4 vs 3, p=0.026), weight (84.7 ± 10.5 vs 80.5 ± 10.2 Kg), Body Mass Index (26.3 ± 3.1 vs 25.2 ± 2.8 kg/m2), body fat (22.3 ± 5.6 vs 18.3 ± 6.5 %), urine specific gravity and urine color. The Hydration Status, in a logistic binary regression model was related significantly with the percentage of body fat (p=0.004), but no relation was found with age, comorbidity and medication. Furthermore, total water intake/weight was positively correlated with percentage of body water (rho=0.357, p=0.000) and negatively with body fat (kg) (rho= -0.427, p=0.000), percentage of body fat (rho= -0.405, p=0.000) and waist/hip ratio (rho= -0.223, p=0.002). The total water intake/weight, in a linear regression model was related significantly with the percentages of body fat (p=0.019) and body water (p= 0,035). No relation was found, however, with waist/hip ratio, age, comorbidity and medication.

Conclusion: All these findings suggest a relationship between hydration status and body composition, but also set the bases for future studies that relate hydration status and anxiety status. These results can be used to improve the hydration status and body composition of military personnel.

1. Background

The optimal functioning of our body requires an adequate hydration level [1], given by a state of water and electrolyte balance [2,3]. The human body has involved to include mechanisms to ensure constant water content by adjusting intakes and wastes. Water balance (WB) is determined by intake (water, beverages, water contained in foods, and metabolic water) and waste (urine, stools, skin, and expired air from the lungs). Failure of these mechanisms and subsequent impairments in WB may produce severe disarrangements [1,4]. Mild, acute, and chronic dehydration can have important implications for human behavior and health. Such implications include short-term memory deficits, impaired problem-solving ability, degraded ability to concentrate, cognitive performance, diminished visual-motor tracking; cardiovascular, and kidney diseases [5-8]. Therefore, maintaining an adequate state of hydration is critical to ensure efficiency during mental and physical activities, as well as playing a key role in mishap prevention through minimizing human error [9]. Human errors are considered the main cause of flight accidents and crashes [10]. In fact, human factors are cited in approximately 70-80% of all accidents in aviation [11]. The complexity of the missions of the air force requires the exercise of a diversity of functions and tasks. The aeronautical military population is vulnerable because of its frequent exposure to a state of hypohydration due to constant physical training, and without having the option of choosing their own desired food (provided in military rationing options during base transfers and/or military exercises). In addition, there are large changes in climatic zones with no acclimatization time [12]. There are several guidelines in scientific literature for establishing recommendations of water requirements, and how to keep an adequate WB [13-16]. However, fluid-balance needs must be individualized for best results [17], because water intake (WI) and water elimination (WE) depends on unique personal characteristics (eg. age, sex, disease states), environmental conditions and physical activity levels that vary in different countries or population groups [18,19]. It has been noted that the percentage of the general population with inadequate WI varies from 5% to 35% among European countries [20]. In Spain, the ANIBES Study (2013) [21] clearly showed that individuals are not consuming the adequate Total Water Intake (TWI) when compared with EFSA reference values (2.0 L/day for females, and 2,5 L/day for males) [13].

Paradoxically, up to the date no study has assessed the Hydration Status (HS) in military personnel in Spain. For these reasons, the purpose of the present study was to evaluate, for the first time, the hydration status of an aeronautical military personnel group in Spain, through a complete and validated questionnaire of hydration [22], as well as anthropometric and biochemical parameters. As a secondary goal, we aimed to investigate a possible relationship between the HS, body composition and anxiety status which could affect the work performance and some abilities in this special population.

2. Methods

The present study was a cross-sectional observational study of a sample of Spanish aeronautical military personnel who attend the annual medical check-ups at the official *Centro de Instrucción de Medicina Aeroespacial* (CIMA), Madrid. From March 2018 to June 2018 (average temperature of 9.2 ºC in March, 12.8 ºC in April, 16.6 ºC in May, and 21.7 ºC in June), subjects from all over Spain, have been informed of the study and invited to participate. The inclusion criteria were individuals who were mentally and physically healthy (which is determined through the various medical consultations, included in the regular medical check-up). Exclusion criteria were (a) people suffering from disease or any special health conditions that limited their flight license and/or (b) individuals suffering from diseases related to hydration status, including renal impairment, urinary tract infection, water balance disease and diabetes. This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the Clinical Research Ethics Committee of the CEU San Pablo University (Madrid). The corresponding ethical code was 119/16/08. All the aeronautical personnel who participate in the study were voluntary and their written informed consents were obtained prior to study.

2.1 Recruitment

The military aeronautical personnel attended to the CIMA for a 2- to 3-day medical check-up period. Recruitment started the first day of medical check-up of each group, and included a volunteer recruitment briefing, with infographics of the procedure of the study. From March 2018 to June 2018 volunteers that expressed interest in participating in the study received the study protocol in writing, as well as verbal responses to any questions. The 6% of the total number of subjects did not consent to participate in the study, or could not participate because they did not meet the inclusion criteria.

2.2 Study Protocol

During the first day, the participants completed the self-reported questionnaires under the supervision of trained dietitian personnel:

1. "The hydration status questionnaire"(HSQ), validated by the Nutrition and Food Science research group of CEU San Pablo University [22], which includes: a) personal information b) medical history c) hydration habits and knowledge d) water, beverages and food frequency questionnaire (WBFFQ) and e) water elimination (WE); to estimate water output three elimination pathways were taken into account: skin, kidneys and digestive system. Urination and defecation were recorded on the basis of frequency, and to calculate sweating, a 10-point scale was used for both, physical activity and sedentary conditions [23]. This information allowed for the assessment of the estimation of WB.
2. A specific designed questionnaire, evaluating physical activity through a brief register of a working day and non-working day activities was used. In this questionnaire, a total of 24 hours were divided into sleeping, eating, work activity , sitting or lying (reading, watching TV...), walking, mode of transport, other activities (specifying domestic tasks, playing with kids...) and sports (specifying which): the total daily energy expenditure (TDEE) was calculated according to their respective metabolic equivalent (MET) intensity levels [24]. This TDEE enabled the estimation of the sweat produced by the physical activity, in order to estimate WE.
3. Anxiety questionnaire (State Trait Anxiety Inventory (STAI)) [25]: a) STAI-State: assessing a transitory emotional state, b) STAI-Trait: that indicates an anxious propensity. The score for each scale can range from 0 to 10, upper scores indicating higher levels of anxiety.

Furthermore, volunteers provided an afternoon (14.00-16.00 PM) spot urine sample, which has an equivalence with the 24-h value of urine (the mean differences (95% confidence interval) between 24-h and spot urine were 0.0014 (-0.0028 to -0.0001)) [26], in which urine pH and urine specific gravity (USG) were determined through the use of urine stick test Spinreact™, as well as urine color, via the Urine Color Chart [27]. Results of USG were compared with reference values of hydration biomarkers in urine afternoon spot [4] (Euhydration values: specific gravity=1018-1020 g/L), and urine color were compared with reference values of Urine Color Chart [27]. As indicated by the urine color chart, values 1,2,3 correspond to well hydrated (WH), 4,5,6 correspond to not enough hydrated (NEH), and 7,8 correspond to dehydrated (DH).

Amstrong et al. [28] indicates that to estimate the hydration status information two or more hydration assessment techniques are needed. Therefore, urine color, WB and total water intake/weight were used to classify study participants with respect to hydration adequacy. Participants that met: urine color = WH [27], WB $\geq$ 0 mL, and total water intake/weight was $\geq$35 mL/kg weight or more [29], were identified as meeting hydration criteria. Participants that met urine color = NEH or DH, WB <0 mL, and total water intake/weight < 35 mL/kg weight, were classified as not meeting hydration criteria. Note that the hydration criteria in this study represent benchmarks for grouping individuals and are not treated as criteria for as dehydration or any clinical diagnosis.

During the second day of the study, the subjects completed the remaining tests under fasting conditions of water and food. First, blood samples were taken for hemoglobin, hematocrit, and erythrocyte analysis. All the determinations were performed in a Cobas Core 501 autoanalyzer (Roche- Hitachi, Swizterland). Then, anthropometric parameters were determined, according to the protocol of the International Society for Advanced Kinanthropometry (ISAK) [30]. Specifically, measurements of weight, height, waist and hip circumferences were taken. Waist/hip ratio was calculated from the equation: waist (cm)/ hip (cm), following the WHO criteria [31]. Body mass index (BMI) was calculated from the equation weight (kg)/height^2 (m^2), and compared to WHO reference values [32]. Body fat percentage and Body Water percentage were determined by Bioelectrical Impedance (BIA) (InBody 770®, Spain). Excessive body fat was defined according to body fat ranges for standard adults reported by Gallager et al. [33], whereas body water percentage was compared with standard ranges between 55-65% [34].

2.3 Statistics

The fact that the size of target population (personnel from Spanish Air Forces) is confidential and not public available, makes it impossible to calculate the exact sample size that allows representativeness. Normality of variables was tested using Kolmogorov-Smirnov test. In light of the results obtained, descriptive values are presented as mean ± standard deviation (SD) or median (interquartile range (IQR)). Differences between normally distributed variables were derived through the Student's t-test. For non-parametric measurements the Mann-Whitney U tests were applied. Urine color was test using Chi^2. Differences were considered significant at $p<0.05$.

Correlation analysis was performed using Spearman's coefficient, or Pearson's coefficient according to variables normality. All the statistical analyses were performed using SPSS 24.0 Software (IBM Corp., Armonk, NY, USA)

A linear regression model was constructed to explore the associations between water intake adjusted by body weight as a dependent variable and body composition variables, age, co-morbidity and medication as independent predictors. Also, logistic binary regression model was used to explore associations between Hydration Status and body composition variables (body fat percentage), age, co-morbidity and medication as independent predictors.

3. Results

3.1 Anthropometric measurements, Blood and Urine markers

A total of 188 healthy males aged 23 to 56 years finally participated in the study (67.6%, 20-39 years, and 32.6% between 40-59 years). The 18 % of the sample presented co-morbidity, and 16 % took medication, unrelated to hydration status. A more detailed description of TDEE, and anthropometric characteristics data of the study population are shown in Table 1. The 50.0 % of the sample showed normal weight rates, the 42.6% overweight, and the 7.4 % obesity according to the BMI. Mean BMI (25.4±2.9 kg/m^2) was considered in the lower range of overweight, according to reference values. However, we observed a percentage of body fat (19.1±6.5%) established as normal in adult men. Furthermore waist/hip ratio (0.87 ± 0.05) in the total sample showed no risk factor for cardiovascular disease. Percentage of body water (60.4±7.5%) in the total sample was also in the range of normal values (55-65%) [34].

Moreover, blood indices (Erythrocyte (5.2±0.4 million/ µl), Hemoglobin (15.2±1.1 g/dl) and Hematocrit (44.7±2.5%)) were within the physiological range [35], as well as the urine markers [36] (table 2).

3.2 Water Intake, Water Elimination and Water Balance

Water from beverages (2709.5±943.6 mL/day), water from foods (795.5±413.7 mL/day), total water intake (3508.9±1112.1 mL/day), water elimination (3402.4±1086.5 mL/day), water balance (88.5±1294.3 mL/day) and total water intake/weight (43.7±14.9 mL/kg), were estimated by the HSQ. Total water intake/weight was correlated positively with percentage of body water (rho=0.357, p=0.000) and negatively with body fat (kg) (rho= -0.427, p=0.000), percentage of body fat (rho= -0.405, p=0.000), waist (rho=0.390, p=0.000), hip (rho= -0.401, p=0.000) and waist/hip ratio (rho= -0.223, p=0.002).

To evaluate the independent relation between total water intake/weight and body composition variables (waist/hip ratio, percentage of body water and percentage of body fat), age, co-morbidity and medication, a linear regression model was used (table 3). The total water intake/weight was significantly related with percentage of body fat (p=0.019) and percentage of body water (p= 0,035). No relation was found with waist/hip ratio, age, comorbidity and medication.

3.3 Hydration Status

It was found that 81 % of the total population met the hydration criteria whereas 19 % did not. Table 4 shows TDEE and anthropometric characteristics, according to the hydration status. Even though there were no statistical differences in anthropometric data according to HS, subjects that did not meet hydration criteria had higher weight (84.7 ± 10.5 *vs* 80.8 ± 10.2 Kg), BMI (26.3 ± 3.1 *vs* 25.2 ± 2.8 kg/m^2) and body fat (22.3 ± 5.6 *vs* 18.3 ± 6.5%), higher waist/ hip ratio (0.9 ± 0.1 *vs* 0.87 ± 0.1), and lower body water (58.1 ± 7.2 *vs* 60.9 ± 7.5%), than subjects that met hydration criteria.

Results of WI, WE and WB are presented in Table 5, and urine markers in Table 6. Subjects that did not meet the hydration criteria had significantly lower water intake from beverages (p=0.002), water from food (p=0.005), total water intake (p=0.000), water balance (p=0.034), total water intake/weight (p=0.000), pH (p=0.023), higher specific gravity (p=0.043) and urine color (Chi2 p=0.000) than subjects that met the hydration criteria. However, differences in blood indices were not observed in both groups (erythrocyte: 5.2±0.3 *vs* 5.2±0.4 million/ µl (p=0.953), hemoglobin: 15.3±0.8 *vs* 15.2±1.1 g/dl (p=0.840) and hematocrit: 44.8±2.3 *vs* 44.7±2.2 % (p=0.710)). Urine and blood indices were within the physiological ranges in both groups [35,36].

To evaluate the independent relation between HS and body composition variables (percentage of body fat), age, comorbidity and medication, a logistic binary regression model was used (table 7). The HS was significantly related with percentage of body fat (p=0.004), whereas no relation was found with age, comorbidity and medication.

3.3 Anxiety Status

Anxiety results showed a low level of anxiety in the total population: score 3 (interquartile range: 2-5) for STAI-State and score 2 (interquartile range: 2-3) for STAI-Trait score. No correlation between STAI (STAI-State and STAI-Trait) and any HS variable was found.

By HS category, significant differences were noted in the anxiety test STAI-State (p=0.026), where subjects that did not meet hydration criteria had higher scores value (4 *vs* 3) than the group that met the hydration criteria (table 8).

4. Discussion

The present study represents the unique exploration of the HS on aeronautical military personnel in Spain, as well as the association of this variable with body composition and anxiety status.

The main findings of our study indicate that TWI was adequate for the majority of the population, in accordance with recommendations established by WHO (3.7 L/day) [16], the National Health and Medical Research Council (3.4 L/day from males) [14] and the Institute of Medicine of the United States of America (IOM) suggest 3.7 L/day for males [37]. Nevertheless, they consumed approximately 40% more of TWI than the EFSA WI reference values for men (2,5 L/day) [13] and the Spanish Society of Community Nutrition (SENC) recommendations [38]. Many studies take into account only the water from beverages but no water intake from all sources (beverages plus food water intake) [39,40]. Previous studies in general European population found that TWI ranges 2310 mL/day in Ireland to 3254 mL/day in Greece [41-45]; and findings in the Spanish population (ANIBES Study) showed intakes of 1625 mL/day [21], much lower than our results. Worldwide, TWI ranges from 2230 mL/day in Japan to 3563 mL/day in the USA [46,47]. Deviation in water intake may reflect country differences in dietary habits, lifestyle choices, and environmental conditions; but also differences in the selection of method used to evaluate total water intake [42].

On the other hand, mean daily WE was 3402.4 mL/day for the whole sample. WE data were in accordance to current literature, which is 1500-3100 mL/day for adults [13,15]. In addition, the WB was positive for the total sample. WI is usually expressed in absolute units (L/day) even though a given L/day intake of water can be expected to have different effects on the hydration status of small versus large individuals [48]. Nevertheless, recent NHANES studies suggest that not accounting for body weight to express WI (mL/kg of weight), may introduce confounding and/or effect modification into hydration studies [48-50]. In addition, the Spanish Guidelines of Hydration suggest that the standard requirements of WI are 30-35 mL/kg of weight [29], data that the present studied sample accomplished.

Laboratory data for urine (USG, urine color, osmolality) are considered good markers to evaluate HS [51]. In the present study urine was measured via color chart in an afternoon urine spot, since USG findings of Bottin et al. [26] suggest that an afternoon sample may be an accurate and practical tool for hydration monitoring.

Blood parameters (hematocrit and hemoglobin) were analyzed due to their potential as HS markers [51]; however, no correlation was observed with any other HS variables in the present study. Francesconi et al. [52] investigated military personnel over field training and reported that even when the subjects had lost more than 3% of their body mass an had a high urine specific gravity, there was no change in hematocrit or serum osmolality measurements. They concluded that plasma volume is defended by the body in an attempt to maintain cardiovascular stability, and therefore plasma variables are not affected by mild hypohydration until a certain degree of body water loss (at least 3% of body mass loss). Similar findings were reported by Armstrong et al. [53].

In our population, 81% of the participants met the established hydration criteria and 19% did not meet the hydration criteria. A US military study showed that 31% of the total sample met the criteria for hypohydration (using USG of first urine of the morning) [12]. Malisova et al. [41] concluded that 60% were euhydrated, 20% hyperhydrated and another 20% dehydrated on average over a seven-day period (using cutoffs of 24 h urine osmolality) in an adult free-living population. Furthermore, they observed that euhydrated subjects had a higher total water intake and water intake from beverages, but lower specific gravity and lighter color. These results are mostly in agreement with our study.

Regarding to anthropometric parameters, BMI suggests overweight values in the total sample. Conversely, the % body fat was considered in the range of healthy values. Several studies observed similar results, and the inability to distinguish the different contributions to body weight, fat and non-fat tissue, which explains why the BMI might overestimate adiposity in muscular and lean body in active people [54,55]. Body water content is an accepted indicator of HS [51]. In this study, this parameter was assessed though BIA, and showed normal values [34]. Although no significance differences were observed according to HS, subjects that did not meet the hydration criteria had higher weight, BMI, body fat (%) and waist/hip ratio than subjects that met the hydration criteria. In addition, total water intake per kg of weight is positively correlated with percentage of body water and negatively with body fat (kg), percentage of body fat and waist/hip ratio for the total sample, demonstrating a relation between hydration status and body composition; following data were noticed in recent studies [56]. Likewise, linear and logistic binary regression analysis showed that percentage of body fat and percentage of body water were independent predictors of water intake normalized by body weight in the study population, as well as the percentage of body fat was independent predictor of Hydration Status. These findings suggest that an adequate water intake could improve body composition. Nevertheless age, co-morbidity and medication was not found to be a significant predictor of water intake normalized by body weight and of HS in the linear and logistic regression analysis. Thus, in addition, body composition parameters should be taken into account in hydration status monitoring.

In our study, subjects that did not meet the hydration criteria had significantly higher scores, in STAI-State, than subjects that met the hydration criteria, indicating a possible relationship between these two variables that should be carefully further evaluated. However, in other studies the relationship between hypohydration status and degraded mood was consistent [8,57]. In additional studies, measuring self-reported changes in mental state have consistently found associations between dehydration and mood, in conjunction with changes in performance [58,59]. Neave et al. [60] tested young adults on a range of cognitive tasks, including attention and working memory, showed that mood ratings significantly change when individuals were given water. Individuals reported feeling more ‘calm’ and ‘alert’ immediately after water consumption. These results are in line with those of other young adult studies that found similar reports of ‘alertness’ after water consumption [61].

The strengths of this study include the novelty in a vulnerable and high-risk group such as the aeronautical military personnel as well as the careful protocol and methodology used.

Even if the present study’s protocol was well controlled, some limitations should be acknowledged. Regarding the HS, the selection of hydration markers may have limitations. The most important limitation refers to the impossibility of directly assessing water consumption, since it has been estimated thought a validated questionnaire. Other limitation refers to the measurement of USG through reagent strips instead of refractometry and the non-availability of 24 hours urine samples.

5. Conclusion

Our results indicate that there is a clear association between hydration status and body composition, but also set the bases for future studies that relate hydration status and anxiety status in the military personnel evaluated. These results can be used to highlight the importance of an adequate hydration status and body composition for military personnel, to maintain a physical and mental performance for their professional career and development.

Abbreviations

Bioelectrical Impedance (BIA)

Body mass index (BMI)

Centro de Instrucción de Medicina Aeroespacial (CIMA)

Dehydrated (DH)

Hydration Status (HS)

Institute of Medicine of the United States of America (IOM)

International Society for Advanced Kinanthropometry (ISAK)

Interquartile range (IQR)

Metabolic equivalent (MET)

Not enough hydrated (NEH)

Spanish Society of Community Nutrition (SENC)

Standard deviation (SD)

State Trait Anxiety Inventory (STAI)

The hydration status questionnaire (HSQ)

Total daily energy expenditure (TDEE)

Total Water Intake (TWI)

Urine specific gravity (USG)

Water balance (WB)

Water elimination (WE)

Water intake (WI)

Well hydrated (WH)

Declarations

Ethics approval and consent to participate

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the Clinical Research Ethics Committee of the CEU San Pablo University (Madrid). The corresponding ethical code was 119/16/08.

Consent for publication

The authors affirm that human research participants provided informed consent for publication of their data

Availability of data and materials

Not applicable.

Competing interests

The authors declare that they have no conflict of interest.

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Authors' contributions

ACK: Conceptualization, Methodology, Investigation, Data curation, Writing - Original Draft, Visualization. CV: Methodology. JMF: Investigation. TTL: Investigation. GVM: Conceptualization, Methodology, Investigation, Writing - Review & Editing, Supervision. NU: Conceptualization, Methodology, Investigation, Writing - Review & Editing, Supervision. AM: Conceptualization, Methodology, Investigation, Writing - Review & Editing, Supervision. All authors read and approved the final manuscript.

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Authors' information

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Tables

Table 1 Anthropometric Characteristics and Total Daily Energy Expenditure of the participants

	Total	
	n=188	
	mean	SD
TDEE (kcal/day)	3158.7	(333.9)
Height (cm)	178.7	(6.2)
Weight (kg)	81.6	(10.3)
BMI (kg/m^2)	25.4	(2.9)
Body water (%)	60.4	(7.5)
Body fat (%)	19.1	(6.5)
Waist/hip ratio	0.87	(0.05)

Table 1 Footnote: TDEE: Total daily energy expenditure. BMI: Body mass index

Table 2 Urine Markers of the participants

	Total	
	n=188	
	median	IQR
pH	6.0	(5-7)
Specific gravity (g/L)	1020	(1015-1020)

Table 3. Water intake adjusted by body weight in a linear regression analysis

	B	**SEM**	**t**	**95%CI**	**p Value**
Waist/hip ratio	-2,330	25,785	-0,090	-53,217 to 48,557	0,928
Body water (%)	0,378	0,178	2,122	0,0264 to 0,729	0,035
Body fat (%)	-0,706	0,212	-3,334	-1,123 to -0,288	0,001
Age	0,187	0,171	1,091	-0,151 to 0,525	0,277
Comobidity	3,354	5,364	0,625	-7,232 to 13,941	0,533
Medication	-0,289	4,981	-0,058	-10,118 to 9,541	0,954

Table 3 Footnote: SEM: standard error of the mean, 95%CI: confidence interval, R = 0.198, R2 = 0.184 and R adjusted = 0.166

Table 4 Total Daily Energy Expenditure and Anthropometric Characteristics categorized by Hydration Status.

	Not Meet Hydration Criteria		Meet Hydration Criteria		p Value
	n=36		n=152		
	mean	SD	mean	SD	
TDEE (kcal/day)	3196.9	(352.4)	3149.6	(329.9)	0.938
Weight (Kg)	84.7	(10.5)	80.8	(10.2)	0.543
BMI (kg/m^2)	26.3	(3.1)	25.2	(2.8)	0.244
Body water (%)	58.1	(7.2)	60.9	(7.5)	0.868
Body fat (%)	22.3	(5.6)	18.3	(6.5)	0.551
Waist/hip ratio	0.9	(0.1)	0.87	(0.1)	0.171

Table 4 Footnote: P-values derived through Student's T-test. TDEE: Total daily energy expenditure. BMI: Body mass index

Table 5 Total Water Intake, Water loss, Water Balance, and Total Water Intake/Weight by Hydration Status

	Not Meet Hydration Criteria		Meet Hydration Criteria		p Value
	n=36		n=152		
	mean	SD	mean	SD	
Water from beverages(mL/day)	1704.4	(489.9)	2947.6	(865.5)	0.002*
Water from food (mL/day)	574.1	(250.4)	847.9	(427.7)	0.005*
Total water intake (mL/day)	2278.4	(473.6)	3800.4	(1016.4)	0.000*
Water loss (mL/day)	3383.3	(1130.9)	3406.9	(1079.5)	0.975
Water balance (mL/day)	-1104.8	(996.6)	371.1	(1193.5)	0.034*
Total water intake/Weight (mL/kg)	27.1	(5.4)	47.6	(13.8)	0.000*
Water loss/Weight (mL/kg)	40.1	(12.4)	42.9	14.9	0.172

Table 5 Footnote: P-values derived through Student's T-test. * Significant differences between groups (Student's T-test, p≤0,05)

Table 6 Urine Markers by Hydration Status

	Not Meet Hydration Criteria		Meet Hydration Criteria		p Value
	n=36		n=152		
	median	IQR	median	IQR	
pH	5	(5-6.5)	6	(5-7)	0.023*
Specific gravity (g/L)	1020	(1015-1020)	1020	(1015-1020)	0.043*

Table 6 Footnote: P-values derived through Mann-Whitney U test. * Significant differences between groups (Mann-Whitney U test, p≤0.05)

Table 7. Hydration Status in a logistic binary regression analysis

	B	SEM	β	95%CI	p Value
Age	0,001	0,030	1,001	0,943 to 1,062	0,974
Medication	-0,250	0,210	0,779	0,267 to 2,268	0,647
Comorbidity	-0,639	1,586	0,528	0,195 to 1,426	0,208
Body fat (%)	-0,091	8,130	0,913	0,858 to 0,972	0,004
Constant	3,431	1,138	30,895		

Table 7 Footnote: SEM: standard error of the mean, 95%CI: confidence interval, R Cox y Snell= 0.72 and R Nagelkerke=0.116

Table 8 Anxiety Status of the participants sorted by the Hydration Status

	Not Meet Hydration Criteria		Meet Hydration Criteria		p Value
	n=35		n=149		
	median	IQR	median	IQR	
State Trait Anxiety Inventory -State	4	(3-5)	3	(2-4)	0.026*
State Trait Anxiety Inventory -Trait	2	(2-3)	2	(2-3)	0.312

Table 8 Footnote: P-values derived through Mann-Whitney U test. * Significant differences between groups (Mann-Whitney U test, p≤0,05)