

ASSESSMENT OF WATER INTAKE FROM FOOD AND BEVERAGES BY ELDERLY IN POLAND¹⁾

Małgorzata E. Drywień, Katarzyna Galon*

Warsaw University of Life Sciences, Chair of Nutritional Assessment, Department of Human Nutrition,
(WULS-SGGW), Warsaw, Poland

ABSTRACT

Background. Fluid intake in elderly is more important than in younger individuals, because compromised homeostatic mechanisms such as loss of the thirst sensation can result in dehydration.

Objective. The aim of the present study was the assessment of water intake from food and beverages by free-living elderly in Poland.

Materials and Methods. The study was conducted on 138 volunteers (women and men) at the age of 60 to 90, recruited from Warsaw and Płock Universities of the Third Age and different informal groups from the same cities. Food and beverages consumption data were collected using the method of records for 3 days, including two weekdays and one week-end day, in the period April – June 2012.

Results. Average values of total water intake in the present study indicated that women meets of the European Food Safety Agency recommendations (2000 mL/day), but men did not (less about 200 mL/day than the recommended 2500 mL/day). Taking into account the criterion of water per energy intake (mL/kcal) 51% of women and 75% of men did not meet the recommendation.

Conclusions. Continuation of the careers and/or participation in Universities of the Third Age contributed to less intake of water from beverages, what in turn affected the total water intake. The elderly leading an active life (working, studying) may be a risk group vulnerable to dehydration, so monitoring is needed.

Key words: *elderly, nutrition, water intake, water, food, beverages*

STRESZCZENIE

Wprowadzenie. Spożycie wody u osób starszych jest znacznie ważniejszym problemem niż u osób młodych, ponieważ zaburzenia w utrzymaniu homeostazy, takie jak utrata odczuwania pragnienia, mogą doprowadzić do odwodnienia.

Cel. Celem badań była ocena spożycia wody z produktami spożywczymi i napojami przez osoby starsze z wybranych rejonów w Polsce.

Materiał i Metoda. Badania przeprowadzono z udziałem 138 ochotników (kobiet i mężczyzn) w wieku 60-90 lat, uczestników Uniwersytetów Trzeciego Wieku oraz osób niezrzeszonych z terenów Płocka i Warszawy. Dane o spożyciu żywności i napojów zbierano z zastosowaniem metody 3-dniowego bieżącego notowania (2 dni powszednie, 1 dzień świąteczny), w okresie kwiecień-maj 2012.

Wyniki. Badania wykazały, że kobiety spożywały wodę na poziomie zalecanym przez Europejski Urząd Bezpieczeństwa Żywności (EFSA) (2000 mL/dz), natomiast mężczyźni spożywali o około 200 mL wody dziennie mniej od tych zaleceń (2500 mL/dz). Przyjmując kryterium spożycia wody w przeliczeniu na jednostkę energii (mL/kcal), okazało się, że 51% kobiet i 75% mężczyzn nie realizuje tych zaleceń.

Wnioski. Kontynuacja pracy/aktywności zawodowej i/lub udział w Uniwersytetach Trzeciego Wieku przez osoby starsze może przyczyniać się do zmniejszenia spożycia wody z napojami, a tym samym całkowitego jej spożycia. Osoby starsze prowadzące aktywny tryb życia (praca, edukacja) mogą być grupą ryzyka szczególnie narażoną na odwodnienie, a więc wymagającą monitoringu.

Słowa kluczowe: *osoby starsze, sposób żywienia, spożycie wody, żywność, napoje*

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*Corresponding author: Małgorzata Ewa Drywień, Wydział Nauk o Żywieniu Człowieka i Konsumpcji, Katedra Żywnienia Człowieka, SGGW w Warszawie, Nowoursynowska 159C, 02-776 Warsaw, Poland; Tel.: +48 22 59 37 121, Fax: +48 22 59 37 123; e-mail: malgorzata_drywień@sggw.pl

INTRODUCTION

Water is one of the most important nutrient for the maintenance of health and life. Fluid intake in elderly is more important than in younger individuals, because compromised homeostatic mechanisms such as loss of the thirst sensation can result in dehydration. Fluid intake is critical for maintaining vascular volume, regulating body temperature, removing waste from the body, and supporting homeostasis [9, 16]. Fluid deprivation and repletion studies comparing younger adults with the older population have demonstrated that despite physiological needs, older people do not consume adequate amounts of fluids to maintain ideal plasma electrolyte concentration [1]. Diminution of liquid intake and increase in liquid losses are both involved in causing dehydration in the elderly [14]. Despite the physiological importance of water to life, little is known about water intake and excretion patterns in free-living elderly [9] and the situation is different in European countries and depends on climate, dietary habits and socio-demographic factors [10, 18, 25]. Population of elderly in the world keeps increasing, that is why more and more stress should be put not only on their treatment but also on their lifestyle and nutritional habits, including water intake and its determinants [20, 25].

The aim of this study was the assessment of water intake from food and beverages by elderly in Poland.

MATERIALS AND METHODS

The study was conducted on 138 volunteers (women and men), at the age of 60 to 90, recruited from Warsaw and Płock Universities of the Third Age (Warsaw UTA group and Płock UTA group, respectively) and different informal groups from the same cities (marked as Warsaw group and Płock group). Food and beverages consumption data were collected using the method of records for 3 days, including two weekdays and one week-end day, in the period April – June 2012. Prior to recording consumption, the survey participants were trained on how to adequately describe the foods and beverages, amounts consumed, cooking methods, etc. At the end of the recording period, the record was thoroughly reviewed with the subject to make records more accurate by clarifying the entries and by adding any omitted items and amounts [4]. Amounts of food and beverages consumed were converted on the amounts of water, energy and selected nutrients using Dieta 5D program created by the National Food and Nutrition Institute (Warsaw, Poland). Intake of water was assessed according to the AI (Adequate Intake) nutritional standards for Polish population: men from 51 to 75 and older – 2500 mL/day; women – from 51 to 75 and older – 2000 mL/day,

and 1.5 mL/kcal of energy intake, and 30 mL/kg body weight [5, 13]. The percentage of individuals who did not follow the recommendation of the European Food Safety Agency [5] for total water intake was calculated. Demographic data, information related to health status and lifestyle factors as well as body mass index (BMI), to investigate their influence on water intake, were evaluated with a self – reported questionnaire.

The informed consent for participation in the study was obtained from each subject. The study protocol has been approved by the Institutional Review Board in Warsaw University of Life Sciences and European Hydration Institute (Madrid).

Statistical analysis

All data are presented as means and standard deviations, minimum and maximum. The distribution of the selected characteristics among groups was compared using analysis of variance (ANOVA). The *Tukey post-hoc* test was used to correct for multiple comparisons. For non-parametric variables the *Pearson χ^2* analysis was used. Statistical significant was set at $P \leq 0.05$. All statistical analyses were performed using Statistica version 10 (StatSoft, Poland)

RESULTS

Characteristics of a study group

In the study group (n=138) the average age was between 65-75 years (Table 1). The youngest female group was from UTA in Płock, and the youngest male group was from Warsaw. There was a significant difference between age of women from Płock UTA and Warsaw ($p < 0.05$). In men such difference has not been observed. Surveyed people lived in two-person households. The least professional active subjects were among those from Warsaw UTA group, and the most active were from the Płock UTA group. A few people reported lack of physical activity. Most subjects had secondary or vocational education. The highest percentage of subjects using healing diets studied at Warsaw UTA, the lowest percentage at Płock UTA. Percentage of smoking individuals was rather similar in all groups. The greater part of the elderly using supplements was reported in Warsaw. Average body size, BMI (Body Mass Index) and WHR (Waist-Hip Ratio) were not significantly different among the study groups.

Selected health factors

Average blood pressure in all groups was on the pre-hypertension (high normal) level and more than half of the population used the medication for hypertension (Table 2). In each study group the android obesity was dominant in women while in men the two types of obesity occurred in similar

proportions. Cardiovascular diseases prevailed between chronic diseases in every group and more than 40% of respondents indicated “other” chronic diseases (Table 2). The main medication was associated with hypertension and “other” diseases, more than 20% of respondents took anti-inflammatory drugs.

Selected indicators of nutrition

The study individuals had regularly meals (4-5 per day) including snacking (data not shown). The average daily intake of energy and macronutrients (protein, fats, carbohydrates, cholesterol, alcohol and dietary fibre) was similar for all study groups. There were significant differences between groups in sodium (without added salt) and potassium intake (Table 3).

Table 1. Socio-demographic and anthropometric characteristics of the studied population

	Płock (n=48, W=33, M=15)	Płock UTA (n=33, W=33, M=0)	Warsaw (n=29, W=24, M=5)	Warsaw UTA (n=28, W=24, M=4)
<i>Average age (years)</i>				
women	70.5±5.8 ^{ac} (62-87)	65.3±3.7 ^b (60-72)	73.4±8.7 ^c (60-90)	66.8±4.7 ^{ab} (62-81)
men	69±4.7 ^a (64-81)	nd	75.8±8 ^a (63-82)	73.3±12.1 ^a (64-91)
<i>Average number of persons per household</i>	2	2	2	2
physical activity (%)	81	88	93	100
professional activity (%)	6	42	21	7
<i>Education (%)</i>				
primary	33	3	14	15
secondary	23	52	52	39
vocational	42	12	10	20
higher	2	33	24	26
Use of healing diet (%)	17	6	24	14
Smoking (%)	13	15	14	11
Use of supplements (%)	13	18	38	54
<i>Average height (m)</i>	1.64±0.73 ^a (1.50 – 1.80)	1.62 ±0.52 ^a (1.53 – 1.70)	1.61 ±0.77 ^a (1.48 – 1.77)	1.65 ±0.66 ^a (1.52 – 1.80)
<i>Average weight (kg)</i>	75.9 ±16.1 ^a (50 – 120)	69.2 ±10.7 ^a (50 – 97)	67.9±13.6 ^a (50 – 95)	70.3 ±11.1 ^a (46 – 98)
<i>Average BMI (m/kg²)</i>	28.2±5.1 ^a (21.0 – 28.2)	26.5±3.6 ^a (18.8 – 37.9)	26.2±4.7 ^a (19.5 – 36.4)	25.9±3.5 ^a (18.9 – 32.6)
<i>Average WHR – women</i>	0.84±0.1 ^a (0.72 – 1.18)	0.92±0.15 ^a (0.69 – 1.36)	0.83±0.07 ^a (0.71 – 0.98)	0.87±0.12 ^a (0.76 – 1.32)
<i>Average WHR – men</i>	0.99±0.09 ^a (0.84 – 1.15)	nd	0.99±0.06 ^a (0.93 – 1.07)	0.97±0.08 ^a (0.87 – 1.07)

Mean ± standard deviation; (Minimum - Maximum), ^{a,b,c} – means in rows marked with the different letter differ significantly at p≤0.05; W - women; M - men; BMI- body mass index; WHR – waist-hip ratio; nd - not determined

Water intake in the elderly

The average daily water intake for women in most groups meets the EFSA recommendation, and the lowest water intake was in Płock UTA group (Table 4). There were no statistically significant differences in water intake among men, but only Warsaw UTA group meets the recommendation. For the average daily water intake with solid foods were not statistically significant differences, but the highest water intake was in Warsaw UTA groups of women and men (Table 4).

The statistically significant lowest water intake from beverages was in Płock UTA group of women. There were no significant differences for water intake from beverages among groups of men. The water intake in relation to the energy was significantly lowest in women of the Płock UTA group, but average intake for women population meets the recommendation. Men in all study groups consumed water at a similar level in relation to the unit of energy (Table 4). Average water intake vs. body weight was similar in women and

men, although this parameter was significantly lower in women of Płock UTA group (Table 4). The highest intake of water was with lunch meal, and then were breakfast and II breakfast, independently of the study group, and in Płock and Warsaw UTA groups snacking

was also the important source of water. Taking into account the average values for study population, the largest volume of water provide lunch and breakfast, and with other meals water was consumed in similar amounts (Table 4).

Table 2. Characteristics of the studied elderly by health factors

	Płock n=48 (W=33, M=15)	Płock UTA n=33 (W=33, M=0)	Warsaw n=29 (W=24, M=5)	Warsaw UTA n=28 (W=24, M=4)
<i>Average blood pressure (mmHg)</i>	132/80	130/79	133/80	124/76
<i>Gynoid obesity (%)</i>				
women	33	12	38	17
men	47	nd	60	50
<i>Android obesity (%)</i>				
women	67	88	63	83
men	53	nd	40	50
<i>Occurrence of chronic diseases (%)</i>				
renal	4	3	10	0
cardio-vascular	73	61	83	61
lung	6	12	10	7
food allergy	0	6	3	0
osteoporosis (women)	8	9	14	4
other	44	27	48	43
<i>Medication (%)</i>				
for hypertension	67	48	69	57
anti-inflammatory	25	24	31	4
laxative	4	12	0	25
diuretic	8	9	14	7
anti-asthmatic	6	9	0	0
other	46	27	52	46

nd - not determined

Table 3. Average daily intake of energy and selected nutrients in studied elderly

Component	Płock	Płock UTA	Warszawa	Warszawa UTA	Average
Total energy (kJ)	6600±2146 ^a (3429 – 14096)	5809±1613 ^a (2725 – 8566)	6196±1870 ^a (2414 – 10151)	6522±2259 ^a (2861 – 12032)	6265±2002 (2414 – 14096)
Total energy (kcal)	1575±513 ^a (817 – 3368)	1387±384 ^a (649 – 2046)	1299±446 ^a (577 – 2603)	1555±539 ^a (682 – 2869)	1495±478 (577 – 3368)
Energy (women) (kcal)	1399±264 ^a (817 – 1963)	1387±384 ^a (649 – 2046)	1355±330 ^a (577 – 2040)	1510±511 ^a (682 – 2722)	1397±374 (577 – 2722)
Energy (men) (kcal)	1964±699 ^a (1089 – 3368)	Nd	2071±484 ^a (1435 – 2603)	1829±707 ^a (1371 – 2869)	1964±639 (1089 – 3368)
Protein (g)	72,2±21,9 ^a (37,1 – 144,9)	67,5±21,2 ^a (23,3 – 108,1)	57,0±21,7 ^a (23,8 – 126,2)	76,9±21,7 ^a (34,8 – 130,5)	70,0±21,8 (23,3 – 144,9)
Fats (g)	50,7±22,2 ^a (21,6 – 126,5)	44,9±17,9 ^a (16,6 – 90,2)	42,1±22,7 ^a (14,0 – 108,6)	56,2±33,1 ^a (21,8 – 138,3)	49,5±24,1 (14,0 – 138,3)
Carbohydrates (g)	216,9±67,7 ^a (117,7 – 463)	194,9±55,4 ^a (86,7 – 310,4)	186,6±69,9 ^a (93,6 – 434,5)	198,9±64,2 ^a (98,0 – 335,9)	205,5±64,7 (86,7 – 463,0)
Sodium (mg)*	3578±1008 ^b (1763 – 6158)	2965±916 ^a (1369 – 4737)	2385±846 ^a (1287 – 4513)	3083±981 ^{ab} (1354 – 5711)	3127±997 (1287 – 6859)
Potassium (mg)	2654±641 ^a (1330 – 4894)	2868±829 ^a (1203 – 5198)	2781±974 ^a (786 – 5216)	3306±907 ^a (1480 – 5026)	2843±845 (786 – 5216)
Cholesterol (mg)	251,4±134,2 ^a (111,2 – 735)	244,4±114,1 ^a (89,7 – 474,6)	203,3±95,1 ^a (46,5 – 465,4)	253,9±139,6 ^a (66,0 – 587)	244,2±122,4 (46,5 – 735)
Alcohol (g)	3,4±11,7 ^a (0 – 164)	0	0,4±2,0 ^a (0 – 13,2)	2,6±5,0 ^a (0 – 74,1)	1,8±7,4 (0 – 249,0)
Dietary fibre (g)	16,9±5,4 ^a (7,1 – 33,1)	18,6±6,0 ^a (7,4 – 30,8)	15,5±6,5 ^a (5,9 – 30,4)	19,3±6,0 ^a (9,5 – 37,4)	17,8±5,9 (5,9 – 37,4)

Mean ± standard deviation; (Minimum - Maximum), ^{a,b,c} – means in rows marked with the different letter differ significantly at p≤0.05; nd - not determined; * Sodium only from products, without salting

Table 4. Average daily water intake in the studied elderly females and males

	Płock	Płock UTA	Warszawa	Warszawa UTA	Average
Total (mL/day)					
Women	2367±531 ^a (1411 – 3821)	1523±526 ^b (553 – 2889)	2006±426 ^{ab} (1109 – 2751)	2283±716 ^a (1104 – 3541)	2032±650 (553 – 3821)
Men	2372±722 ^a (1222 – 3469)	Nd	2167±576 ^a (1525 – 3074)	2536±653 ^a (2075 – 3502)	2360±663 (1267 – 3502)
Average	2368±589 ^a (1222 – 3831)	1523±526 ^b (553 – 2889)	2033±447 ^a (1109 – 3074)	2319±701 ^a (1104 – 3541)	2085±661 (553 – 3821)
With solid food (mL/day)					
Women	658±128,0 ^a (376,6 – 879)	692±202,1 ^a (301,0 – 1141)	669±248,2 ^a (325,5 – 1387)	763±187,1 ^a (359,5 – 1150)	692±193,3 (301 – 1387)
Men	875±331,7 ^a (571 – 1894)	Nd	751±225,3 ^a (415,1 – 990)	908±158,6 ^a (671 – 1004)	855±286,6 (415,1 – 1895)
Average	725±233,0 ^a (376,6 – 1893)	692±202,1 ^a (301,0 – 1141)	683±242,6 ^a (325,5 – 1387)	783±187,9 ^a (359,5 – 1150)	720±220,1 (301,0 – 1895)
With beverages (mL/day)					
Women	1615±556 ^a (583 – 3211)	766±471,8 ^b (148,3 – 2171)	1234±355,9 ^a (649 – 1939)	1453±707 ^a (253,0 – 2667)	1255±628 (148,3 – 3211)
Men	1389±583 ^a (252 – 2363)	Nd	1285±407,0 ^a (937 – 1988)	1502±596 ^a (915 – 2310)	1387±535 (252,2 – 2363)
Average	1545±568 ^a (252,2 – 3211)	766±471,8 ^b (148,3 – 2171)	1243±357,9 ^a (649 – 1988)	1460±682,7 ^a (253,0 – 2667)	1278±613 (148,3 – 3211)
(mL/kcal)					
Women	1,8±0,5 (0,9 – 2,9)	1,1±0,4 (0,6 – 1,9)	1,6±0,5 (0,8 – 2,8)	1,7±0,9 (0,5 – 4,4)	1,5±0,6 (0,5 – 4,4)
Men	1,3±0,5 (0,8 – 2,3)	nd	1,1±0,3 (0,7 – 1,5)	1,4±0,2 (1,2 – 1,7)	1,3±0,4 (0,7 – 2,3)
Average	1,6±0,6 (0,8 – 2,9)	1,1±0,4 (0,6 – 1,9)	1,5±0,5 (0,7 – 2,7)	1,7±0,8 (0,5 – 4,4)	1,5±0,6 (0,5 – 4,4)
(mL/kg body weight)					
Women	33,8±9,4 (18,6 – 54,1)	22,6±9,5 (10,4 – 49,2)	31,5±8,5 (18,3 – 48,8)	34,1±11,9 (15,7 – 58,9)	30,2±10,9 (10,4 – 58,9)
Men	28,8±9,7 (12,2 – 51,0)	nd	27,6±9,1 (19,6 – 43,3)	31,4±4,0 (27,6 – 35,7)	29,0±8,7 (12,2 – 51,0)
Average	32,2±9,7 (12,2 – 54,1)	22,6±9,5 (10,4 – 49,2)	30,9±8,6 (18,3 – 48,8)	33,7±11,1 (15,7 – 58,9)	29,9±10,5 (10,4 – 58,9)
(mL/meal)					
Breakfast	400,0±154,2 ^{ab} (90,1 – 1038)	319,9±172,4 ^a (84,1 – 827)	428,2±145,8 ^{ab} (201,3 – 739)	464,4±210,0 ^b (149,0 – 1070)	399,8±175,2 (84,1 – 1070)
II breakfast	316±211,6 ^a (0 – 1021)	207,6±158,7 ^a (0 – 853)	311,6±150,5 ^a (0 – 696)	275,2±190,6 ^a (0 – 776)	280,8±187,0 (0 – 1021)
Lunch	630±165,4 ^a (267,7 – 998)	530,5±170,0 ^a (210,3 – 920)	596±163,3 ^a (293,6 – 989)	563±193,3 ^a (197,9 – 999)	585±174,2 (197,9 – 999)
Tea-time	277,1±144,6 ^a (0 – 749)	175,4±160,6 ^b (0 – 633)	224,6±141,0 ^{ab} (0 – 497,5)	212,5±151,1 ^{ab} (0 – 468,7)	228,6±152,7 (0 – 749)
Dinner	285,8±148,6 ^{ab} (0 – 692)	219,9±157,6 ^a (0 – 642)	325,0±149,1 ^{ab} (0 – 748)	377,8±177,7 ^b (64,9 – 810)	296,9±164,7 (0 – 810)
Snacking	459,1±503,3 ^a (0 – 2166)	75,6±171,7 ^b (0 – 707)	99,4±162,8 ^b (0 – 667)	425,5±545,4 ^a (0 – 1833)	285,0±436,3 (0 – 2166)

Mean ± standard deviation; (Minimum - Maximum), ^{a,b,c} – means in rows marked with the different letter differ significantly at $p \leq 0.05$; nd - not determined;

More than half of the studied population, both women and men, consumed daily less water than recommended. Over 80% of women in Płock UTA group and men in Warsaw group did not meet the EFSA recommendations (2000 mL/day for women; 2500 mL/day for men). All males in the Warsaw group consumed insufficient amount of water in relation to 1 kcal of energy. Only in the Płock group more than 70% of females meet the recommendation (Table 5).

Table 5. Percentage of individuals who did not meet the recommendations

	Płock	Płock UTA	Warszawa	Warszawa UTA	Average
for total water intake (mL/day)					
Women	27	82	46	46	51
Men	54	nd	80	75	58
Average	33	82	48	54	52
for water intake relative to energy (mL/kcal)					
Women	30	82	42	46	51
Men	72	nd	100	50	75
Average	44	82	52	46	55
for water intake relative to weight (mL/kg body weight)					
Women	42	88	54	38	57
Men	53	nd	80	50	58
Average	46	88	59	39	57

Table 6. Coefficients of the *Pearson's* correlation between selected factors and water intake among study population of elderly (at $P \leq 0.05$; at $P \leq 0.1^*$)

Factors	Total water intake	Water intake with solid foods	Water intake with beverages
Participation in UTA	-0.35	0.15*	-0.37
Gender (women)	-0.17*		
Age	0.18*	-0.18*	0.19
Height	0.16*	0.19	
Weight	0.17*	0.25	
BMI		0.18*	
Professional activity	-0.29		-0.27
Use of supplements	0.18		0.20
Smoking	-0.24	-0.17*	-0.19
Other diseases		-0.24	
Medication	0.21		0.20
Anti-inflammatory medication		-0.21	
Other medication	0.21		0.22
Number of meals per day	0.21	0.26	0.19
Warm meals		0.26	
Soups		0.19	
Energy intake	0.26	0.34	
Protein intake	0.26	0.43	
Fats intake		0.22	
Carbohydrates intake	0.27	0.29	
Dietary fiber intake	0.20	0.36	
Sodium intake	0.28	0.39	
Potassium intake	0.27	0.52	
Total water intake		0.24	0.94
Breakfast	0.62		0.59
II breakfast	0.54		0.53
Lunch	0.47	0.28	0.33
Tea-time	0.41		0.38
Dinner	0.47	0.26	0.41
Snacking	0.55		0.57

Blank cells indicate no significant correlations

No significant correlations were found between occurrence of chronic diseases (renal, cardio-vascular, lung, food allergy, osteoporosis), education, blood pressure, physical activity, and healthy diet and water intake. The correlation coefficients indicated strong relationship between selected factors and water intake in the study population of elderly (Tab. 6). Participants of the University of the Third Age (UTA groups) consumed less water in total and from beverages but consumed more water from solid food than individuals gathered in informal groups. The negative correlation was observed between gender (women) and total water intake. Water intake from beverages increased with the age of respondents, and body sizes (height and weight) affected water intake from the solid products. Older individuals consumed more water in total but less from solid food. Professional activity among elderly and smoking resulted in lower total water consumption and water from beverages. The use of supplements and most medications favoured a greater intake of water from beverages, what in turn resulted in higher total water intake. However the anti-inflammatory medication was negatively correlated with the intake of water of solid food.

The greater number of meals per day, the higher water consumption with any type of food. Moreover the presence of warm dishes and soups increased water intake from solid products. Intake of energy, macronutrients, sodium and potassium positively correlated with total water consumption and water of solid products. A strong relationship has been established between the presence of each meal and the consumption of total water and water from beverages, although only eating of lunch and dinner positively correlated with water from solid food.

DISCUSSION

The main objective of this study was to assess the water consumption and its determinants among a selected population of elderly with particular emphasis on the educational activity in old age. The elderly in Poland has not been studied in details as far as diet and especially water consumption concerns. The latter one is a key component to their well-being and health.

There is a big change in a lifestyle when people retire because they can cease some activity or undertake a new one (eg. learning, physical activity). Some of them continue their careers. The changes in activity substantially influence the way of nutrition.

The diet of the population in this study was characterized by great regularity and the occurrence of snacking. This is confirmed by the study of *Kolajtis-Dolowy* et al. [15], who found on past and present habits of centenarians, that with age the

frequency of breakfast consumption increases (from 86% of the respondents before the age of sixty to 97% at present), second breakfast (from 24% to 35%) and dinner (from 72% to 93%), afternoon tea (from 7% to 24%), supper (from 76% to 83%) and snacking (from 17% to 31%). The study of *Łagiewka* and *Sznajder* [17] also indicated a similar relationship between age and eating habits. They have established that 62% people aged over 64 years dined three times a day, and 30% - more often. Over 50% of the study population ate at fixed time and more than 90% consumed at least one warm meal per day. These results show a better quality of nutrition among elder people, and the greater stress put on a regular diet, and are similar to results of the present work.

The study women did not meet recommendations for energy intake, but the men did [13]. Similar results were obtained by *Wyka* and *Biernat* [26] in Wrocław, and *Różańska* et al. [23] in small town Twardogóra, among the elderly. Moreover, it has been shown that the diet has changed over the last twenty years. The energy intake from daily consumption has significantly decreased from 2130 kcal in 1990 to 1455 kcal in 2006. A similar consumption for men in these years decreased by 1000 kcal. Similarly the study on nursing home residents demonstrated an energy deficit in the diet of both women and men; despite care they had [22]. However *Grochowska-Niedworok* et al. [12] have shown significant excess in energy intake in residents of four nursing homes in Silesia. Based on the results of present study and the some reports of other authors it can be concluded that after 2006 the energy consumption among the elderly over the age of 60 stabilized at about 1400 kcal for women, about 1900 kcal for men. The energy intake in women can also be affected by the place of residence. This study found that women living in Warsaw and Płock consumed less energy (about 300 kcal/day) than women living in rural areas [24]. However the place of residence did not have the same effect on male subjects.

In the study population of Płock and Warsaw protein intake exceeded the recommended values. However the amount of fats, carbohydrates and fibre was too low. In the study of elder people living in nursing home *Pysz-Izdebska* et al. [22] showed, in turn, proper protein intake among women and men, and too high fat intake among men, and too low carbohydrate and dietary fibre intake in both gender groups. The study conducted between 2002 and 2005 on people aged 25 - 64 by *Bolesławska* and *Przysławski* [3] confirmed this trend for protein, carbohydrate and fibre intake, however in the case of fat results were inconsistent. Only *Grochowska-Niedworok* et al. [12] reported too high intake of protein and fat in institutionalized elder persons in Silesian region. In terms of cholesterol studied subjects from Płock

and Warsaw showed adequate consumption of this nutrient (about 240 mg). Observed differences could result from a different age of the population, but it can be concluded that elder people pay more attention to the consumption of atherogenic food ingredients. The tendency to reduce intake of fats and carbohydrates may result from desire to reduce energy consumption, as demonstrated by the study of *Górecka et al.* [11] concerning the sanatorium patients in Ciechocinek. It has been found that elder people who are overweight (especially women) chose low fat products (especially cottage cheese, milk, low fat yogurt, and sugar-free drinks such as tea and coffee) unlike people of normal body weight.

It is disturbing in our study that sodium intake was two-fold higher than the AI standard [13], the more that it was the only sodium from products without salting. Potassium intake was less than half of AI. The proportions of sodium to potassium from the appropriate 57:120 Mmol to 152:66.7 Mmol in daily diet been heavily modified, which may strongly affect the management of electrolytes in the organism. This problem requires a separate study in terms of the treatment of hypertension.

Average values of total water intake in the present study indicated that women meets the EFSA recommendations, but men did not (less about 200 mL/day). However the percentage of women and men who did not meet the EFSA recommendations was similar (51% and 58% respectively). These data can be considered satisfactory, since the previous obtained by *Pietruszka and Krajewska* [21] showed that only 14 (for $n = 206$) of respondents carries out recommendations. Taking into account the comparative data from Sweden we can find better hydration of the elderly in Poland [7]. It can be considered that the situation of the elderly in Poland in terms of hydration is slowly improving, but still diet of older people in Poland is not well recognized. Regardless of the total volume of water consumed about 35% came from the solid food and 60% or more - from beverages. Similar proportions was stated in Germany among people over 65 years [19], however data for general population indicate that 70-80% of water came from beverages and the rest from solid food [6, 10, 18]. Despite this the results of *Gibson and Shirreffs* [10] helped confirm that age affects the proportions in supplying water by beverages and solid food, from 77% to 73% and from 23% to 27% respectively. This regularity is strongly emphasized in the present studies and it may be an important finding. It can probably be explained by an increased consumption of dishes with high water content i.e. warm vegetable and milk soups, popular in polish diet, especially among elderly, what was confirmed by correlation coefficients. Factors influencing this phenomenon in other countries should be studied.

Taking into account the criterion of water per energy intake (ml/kcal) 51% of women and 75% of men did not meet the recommendation. This is disturbing because it indicates a high risk of poor hydration and this indicator seems to be more sensitive than EFSA's AI or water volume intake per 1 kg of body weight, and could be more applicable across age and gender groups. *Gibson and Shirreffs* [10] also paid attention to the importance of this measure. The second important finding of the present study is the confirmation, that total water intake in older people should be assessed in the context of energy consumption, especially that older tend to its limitation.

In the studied population most water was consumed at lunch and breakfast. These are the most important meals in the diet of elderly in Poland and the lunch is the main meal. Respondents consumed approximately 20% of total daily water during breakfast, mostly from beverages and approx. 30% - during lunch. Similar results were obtained for Spanish seniors [8] and French adults [2]. Including second breakfast more than 60% of total daily water was consumed before 15.00 h (lunch time), and so in time of greatest activity of respondents, when the water consumption should be the highest. The *Pearson* correlations indicated a strong influence of beverages here. These observations are similar to [10]. From the point of view of the elderly, such regularity is beneficial, regardless of the type of the activity that the majority of respondents showed.

The physical activity increases water losses what should exceed the water intake [14] and in older people too [8]. In the present study this regularity was not observed, although the over 80% respondents declared practice exercises. However the third important finding of our study is the determination of the adverse effects of other activities of the population studied on the water consumption. Continuation of the careers and/or participation in UTA's contributed to less intake of water from beverages, what in turn affected the total water intake. In interviews, respondents emphasized that they have a lot of activities during the day and it prevents them from frequent and regular consumption of beverages. Meal time is essential for consuming beverages. On this basis, it can be assumed that any activity recommended for the elderly improving their overall well-being [16] may adversely affect the status of their hydration.

The main limitation of our study may be a number of respondents but sometimes it is difficult to get a large number of adequately reliable data in this age group. Despite this, the current results showed an improvement in hydration of elderly people in Poland over the last 10 years.

CONCLUSIONS

1. This study reports that approximately half of the studied elderly women and men aged over 60 years did not meet the EFSA recommendations for total water intake.
2. Small value of the water vs. energy intake ratio is even more worrying, because it concerns a higher proportion of elderly, particularly males.
3. The recommendations for the elderly concerning nutrition and various forms of activity should include detailed information on a regular and proper hydration. This is particularly important in the context of age-related diseases and medication, which are often associated with water-electrolyte balance.
4. The elderly leading an active life (working, studying) may consist a risk group vulnerable to dehydration, so monitoring is needed.

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Conflict of interest

The authors declare no conflict of interest.

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