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THE EFFECT OF DAILY WATER INTAKE ON BLOOD BIOCHEMICAL MARKERS IN HEALTHY INDIVIDUALS

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ABSTRACT

Objective
Water is one of the most important elements for human life and an essential part of general nutrition. Water plays crucial roles in proper functioning of body parts, metabolic balance and various biochemical reactions. Adequate daily water consumption is vital for metabolism. The current study was designed to determine the effects of daily water consumption on blood biochemical markers in healthy individuals.
Methods
This study was performed 50 healthy volunteers (17 male- 33 female) and aged 21-55 years. Two groups which consuming < 2 liters of water per day and consuming ≥ 2 liters of water per day created based on their interview and answers for the given survey. Serum fasting blood glucose, total protein, albumin, urea, uric acid, creatinine, sodium, potassium, chlorine, calcium and phosphorus levels were measured in blood samples.
Results
The results of this study shows that there is a significant difference of water drinking behavior between male and female where female drink more water than male. Serum urea, uric acid, creatinine and sodium levels increased significantly in the group consuming < 2 liters of water per day than the group consuming ≥ 2 liters of water per day ($p<0.05$).
Conclusion
Water contributes to cell duplication and it also helps formation of urine to clear the body from toxins. In our study, the higher levels of urea, uric acid and creatinine in the group consuming < 2 liters of water per day may be explained by more effective functioning of kidneys and toxin removal in the group consuming ≥ 2 liters of water per day. The current study relates water intake with biochemical parameters in healthy individuals.

Keywords: Daily water intake, biochemical markers, health

INTRODUCTION

Water is one of the most important elements for human life and an essential part of general nutrition (1). Water is essential to life and we cannot live more than a few days without water. Water has indeed many functions in the body: it is the building material for cells and body fluids; it acts as a reaction medium, as a solvent and as a reactant. It is even the transporter of nutrients and helps in the elimination of body wastes through urine. It is necessary for the control of body temperature through sweat evaporation. Water plays important roles in proper functioning of body parts, metabolic balance and various biochemical reactions (2).
Water is the major component of the human body; it composes on average 60% of the body weight in adult men, and 50-55% in women (3). This means that, for a man of average weight (70 kg), body water content is about 42 liters. But this average value may vary among individuals, primarily because of differences in body composition (4). Women and older persons have lower total body water, because of lower fat-free mass. In contrast, athletes have relatively high total body water(5). The water content of varied organs depends on their compound, so ranges from 83% in blood to only 10% in adipose tissue.
Adequate daily water consumption is vital for metabolism. Age, gender, weight, physical environment, seasonal changes, exercise, diseases and drugs taken are among the factors that affect water intake (6). Body's need for water increases in extremely cold or hot weather conditions to maintain its physiological temperature. In hot and humid air, fluid loss is increased by excessive sweating. That's why, it is important to increase fluid intake, as outside temperature is starting to rise. Water consumption needs to be increased during exercise, air and sea cruises and after urination or defecation (7).
There are several studies in the literature which analyzed effects of water intake on human health (8, 9). Today, either upper or under water consumption limits have not been clearly related to a certain benefit or risk. Although a consensus has not been reached scientifically, daily water consumption of 8 glasses (2 liters) is recommended (10-12). The current study was designed to determine the effects of daily water consumption on blood biochemical markers in healthy individuals.

MATERIALS AND METHODS

Study design and Participants

This study was performed at the Department of Biochemistry of Ankara Polatlı Public Hospital, Turkey. The subjects were hospital staff and aged 21-55 years. 50 healthy volunteers (17 male- 33 female) were included in this study. We excluded volunteers with any acute or chronic disease or medication or any addiction except smoking during the study. Volunteers answered a survey about their water drinking habits. In this survey there were questions about their age, gender, weight, having any disease, medication use, alcohol use, smoking habits, amount of water they drink daily, the reasons of not enough drinking (other fluid intake like tea, coffee, beer, soda, etc.) Two groups which drinks less than 2 liters of water and more than 2 liters of water daily created based on their interview and answers for the given survey.
This study was approved by the ethical committee from the research office of Ankara Polatlı Public Hospital and volunteers gave informed consent for participation in the study.

Blood samples and laboratory analysis

The fasting blood samples were taken from all subjects. Venous blood samples were taken, placed in gel containing tubes and centrifuged at 4000 rpm for 10 min to analyze the separated serum. Hemolysed and icteric serums were not used in this study.
Serum fasting blood glucose, total protein, albumin, urea, uric acid, creatinine, sodium, potassium, chlorine, calcium and phosphorus levels were measured by an enzymatic colorimetric method in a C8000 Architect Abbott auto analyzer (Rungis, France) using original commercial kits.

Statistical analysis
In this study, we created two groups according to their water drinking habits (consuming < 2 liters of water per day and consuming ≥ 2 liters of water per day). We compared with respect to our results between these two groups. Statistical Package for the Social Sciences (SPSS) 20.0 was used for the analysis. In the statistical review of the results, the Kolmogorov–Smirnov test was used to determine whether the parameters were normally distributed. Results were expressed median and minimum-maximum. Mann-Whitney U and chi-squared test were used for data analysis. A p-value of less than 0.05 was considered to be statistically significant.

RESULTS

The results that compare the two groups are given in table 1. The results of this study shows that there is a significant difference of water drinking behavior between male and female where female drink more water than male ($p<0.05$)(Figure 1). There is no significant difference between groups with respect to smoking habits, that in both groups, smokers are less than nonsmokers. Volunteers that consuming < 2 liters of water per day told that higher tea consumption as the reason for their less water consumption. Serum urea, uric acid, creatinine and sodium levels increased significantly in the group consuming < 2 liters of water per day than the group consuming ≥ 2 liters of water per day ($p<0.05$) (Figure 2). But there were no significant changes in serum fasting blood glucose, total protein, albumin, potassium, chlorine, calcium and phosphorus levels in both group ($p>0.05$).

Table 1. Comparison results between the two groups

	consuming < 2 liters of water per day	**consuming ≥ 2 liters of water per day**	**p**
n	26	24	0,630
Gender	14 M/12F	3M/21 F	**0,002***
Smoking habits	%30,8	%33,3	0,846
Age (year)	37 (27-55)	35 (21-44)	0,176
Weight (kg)	75,5 (47-98)	67 (53-110)	0,127
Fasting blood glucose (mg/dl)	97 (77-120)	94 (75-160)	0,555
Total protein (g/dl)	7,3 (6,6-8,1)	7,25 (6,7-8,8)	0,539
Albumin (g/dl)	4,50 (4,1-5,1)	4,55 (4-5)	0,845
Urea (mg/dl)	5,3 (3,6-7,1)	4,05 (3,1-8,3)	**0,004***
Uric acid(mg/dl)	26,4 (15,8-44,7)	20,6 (13,7-39,9)	**0,002***
Creatinine (mg/dl)	0,79 (0,61-0,96)	0,66 (0,59-0,81)	**0,001***
Sodium (mmol/L)	139,5 (134-142)	139 (134-141)	**0,012***
Potassium (mmol/L)	4,39 (3,74-4,93)	4,4 (3,80-4,77)	0,892
Chlorine (mmol/L)	106 (98-110)	106 (102-109)	0,510
Calcium (mg/dl)	9,20 (8,5-10)	9,05 (8,6-9,9)	0,725
Phosphorus (mg/dl)	3,66 (2,76-5,05)	3,54 (3,1-4,43)	0,587

* There is a significant difference between two groups.

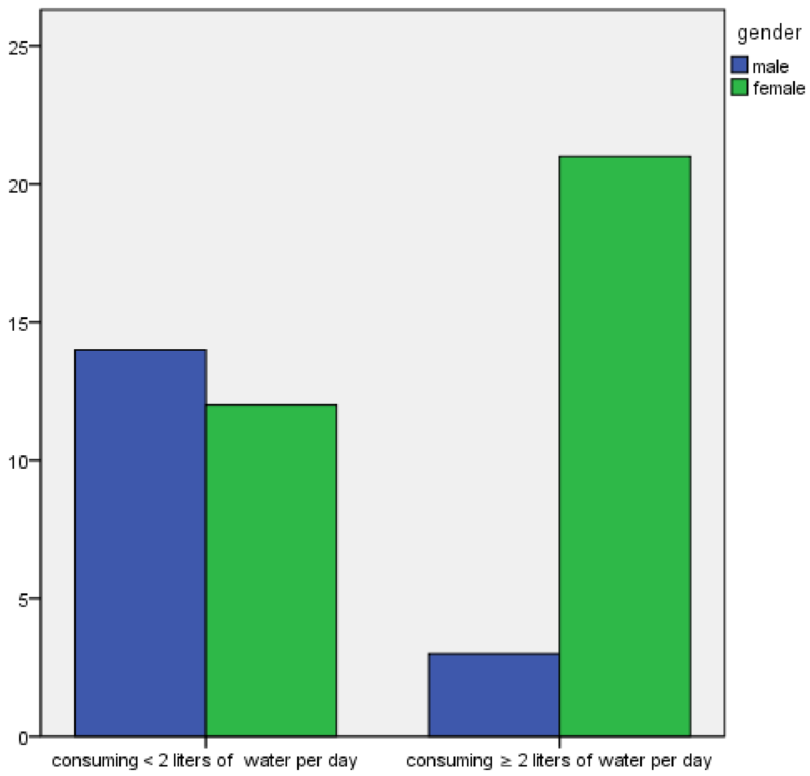
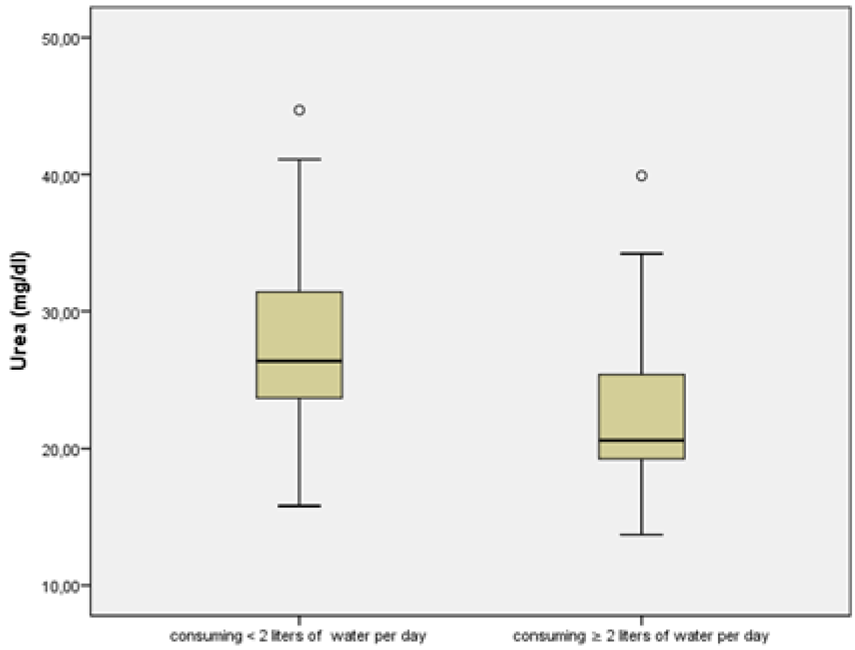
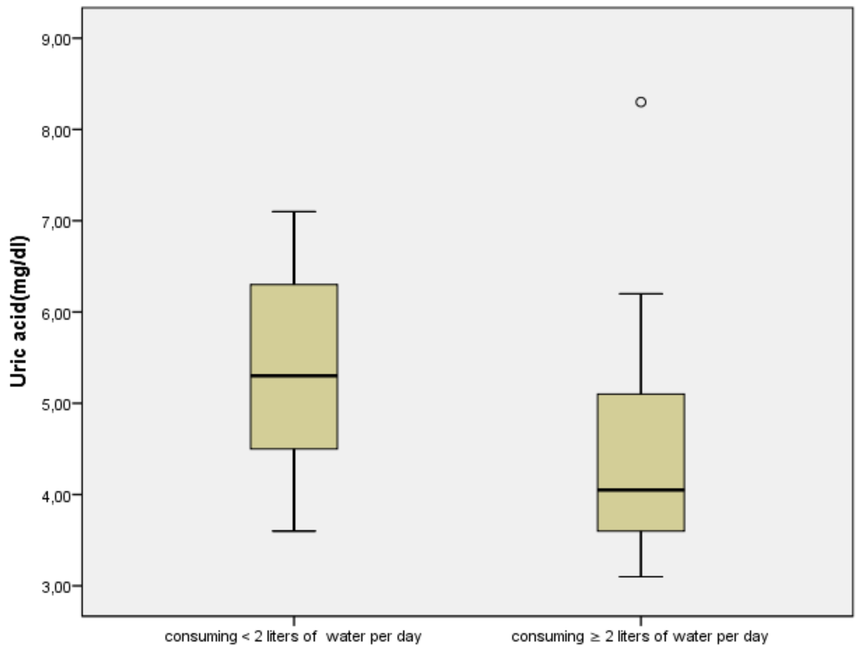
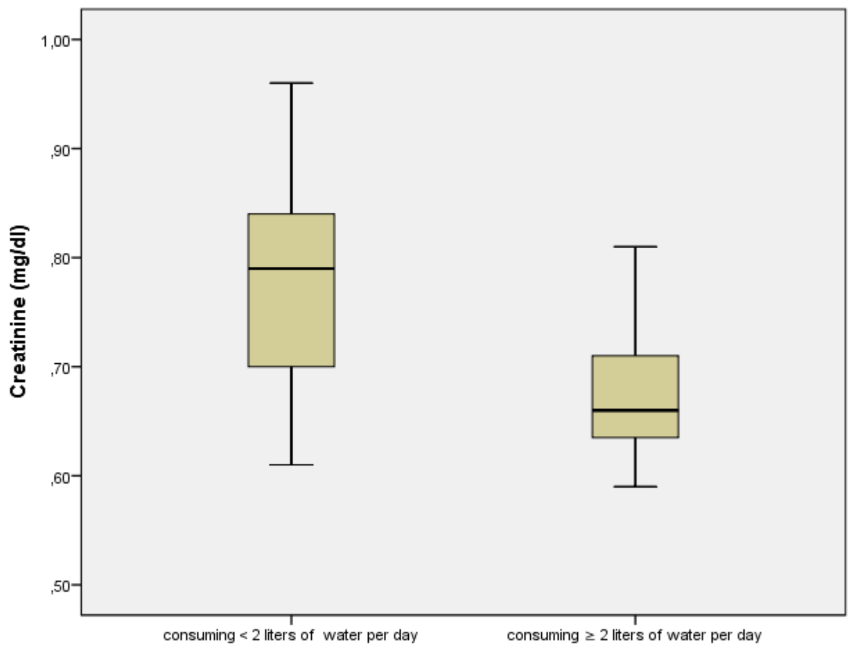


Figure 1. Comparison of genders of two groups




Uric acid(mg/dl)
9,00
8,00
7,00
6,00
5,00
4,00
3,00
consuming < 2 liters of water per day
consuming ≥ 2 liters of water per day


Creatinine (mg/dl)
1,00
,90
,80
,70
,60
,50
consuming < 2 liters of water per day
consuming ≥ 2 liters of water per day

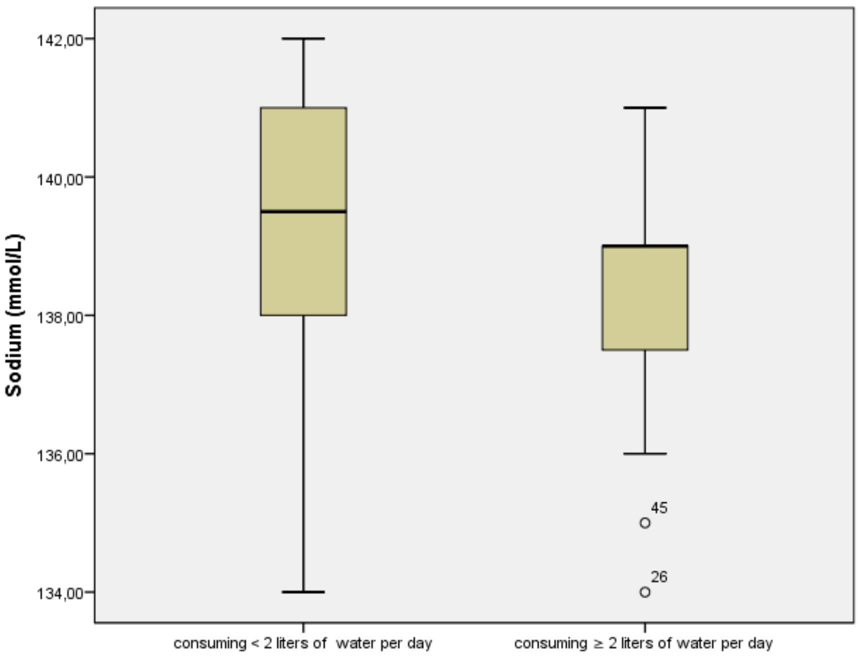


Figure 2. Comparison of uric acid, urea, creatinine and sodium levels of two groups

DISCUSSION

Water, accounting on average for 60% of the body weight, is the largest component of the human body (3). It is distributed throughout the body, in every organ, inside and between cells. Water is a crucial element in digestion, absorption and transfer of food to cells, proper functioning of tissue and organ systems, excretion of toxic materials from the body, functioning of digestive system, maintenance of body temperature and occurrence of many biochemical reactions.

The fluid need of human body is generally met by basically three sources: drinks, food and metabolism. Water is generated as a result of food metabolism. Dietary fluid intake should supply for the body water losses. Drinking water and other drinks represent 70 to 80% of total fluid intake, while water coming from food represents about 20-30% of the total intake. Daily consumption of tea, coffee, soda etc. are also a source of liquid for the body. In this study, volunteers in the group consuming < 2 liters of water per day told that higher tea consumption as the reason for their less water consumption. But drinks containing caffeine like tea and coffee are not considered as proper water sources as caffeine has a diuretic effect and favors liquid loss by increasing urination (13).

The primary sources of water losses from the body are urine and sweat, but water is also lost through feces, skin and breathing. Body water balance is tightly regulated, and the adjustment of urine volume is crucial for this regulation. The kidneys are able to concentrate or dilute urine, urine concentration depends on the metabolic wastes to be excreted and on the quantity of water to be excreted (14) .

Water helps formation of urine to clear the body from toxins (15). In our study, the higher levels of urea, uric acid and creatinine in the group consuming < 2 liters of water per day may be explained by more effective functioning of kidneys and toxin removal in the group consuming > 2 liters of water per day. Again the lower Na levels in the group consuming > 2 liters of water per day may be explained by moderate polydipsia due to hydration. There are several publications about preserving kidney, heart and general body health by adequate water intake (16-19). Some studies suggest that high fluid intakes, and therefore high urine volumes, could slow the decrease of kidney function which occurs with aging, and protect against chronic kidney disease (19-21). Recent observational studies suggest a strong, direct association between preservation of renal function

and fluid intake, but water's use for medicinal purposes is not universally accepted (1). The healthy human body is able to adapt to insufficient water intake, thanks to the wide ranges of urine osmolality kidneys are able to achieve. However, the long-term health consequences of low or high fluid intake have been researched. This researches indicate that chronic low water intake may poorly impact kidney health. As it may be associated with a more rapid decrease of kidney function and higher risk of chronic kidney disease. However, there is not enough research about the amount of optimal water required to prevent disease or improve health. Additional research is therefore needed to measure the optimal daily water consumption.
Most of the guidelines for total water intake are based today on median population intake. The water intake (food + fluid) recommendations of international authorities is variable, from 2.5/day in Europe to 3.7L/day (for men) in the United States and Canada(5, 22) International recommendations about total water intake vary considerably. So international authorities should publish more standard water intake guidelines for every demographic groups, such as adult, children, pregnant and breastfeeding women and residents of hot climates.
The current study relates water intake with biochemical parameters in healthy individuals, which has not been studied before. The study created with low number of healthy volunteers. That's why; this study needs to be carried out in larger groups to make a better contribution to science.

Limitation

The study has its own limitations like low number of healthy volunteers, observation of water intake pattern of the volunteers for a short time period and going back from results to reasons.

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Conflict of interest: Authors do not have any conflict of interest

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