

The Use of Water and Other Liquids of Different Chemical Composition for Hydration in Movement Activities

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Abstract: *The main purpose of this study was to identify the types of water and other drinks used for hydration by those who perform movement activities and also to analyze the quality of these drinks. As a result of performing movement activities, through perspiration, a greater or lesser amount of water is lost from the body. Along with this, a number of nutrients are lost. Given these aspects, the main objective of the research was to understand correctly, what is involved in proper hydration, which are the factors that must be taken into account to maintain good health. We analyzed and compared the level of the main electrolytes and carbohydrates for different categories of drinks and also measured with the help of two specific devices the level of purity and pH of three categories of drinking water. We indicated general values regarding the ratio of water consumption to weight on the one hand, and on the other hand, we indicated the indicative quantities that should be consumed before, during and after performing medium-level physical effort. As a general conclusion, the importance of sodium, alkaline water and high water purity was highlighted in relation to the categories of beverages analyzed in this study.*

Keywords: *proper hydration, fluid quality, physical effort.*

1. Introduction

Water is the main element that makes up the human body, its share being about 60% of body weight. Proper hydration is necessary to maintain good health, for the optimal functioning of basic body functions such as blood pressure, thermoregulation, brain function, digestion etc. Mild dehydration (2% water deficiency) can cause headache, decreased ability to concentrate and maintain attention, constipation, decreased physical performance [1, 2].

The relationship between fluid ingestion and movement activities is also dependent on their location, knowing that both high-altitude exercise can lead to dehydration [3] and low-intensity exercise (sea level), where the air has a high content of water vapor [4], creates discomfort, disrupting the function of perspiration.

The importance of proper hydration has a special meaning when we refer to the movement activities of various forms: physical education, leisure or play activities and especially performance sports. By sweating, a greater or lesser amount of water is lost from the body, depending on the volume, intensity and complexity of the effort, the ambient temperature, the level of momentary physical training and the surface of the body. The muscles of the human body maintain the locomotion and generate strength and heat, its composition being 75-80% water, and 20-25% being dry matter.

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At the level of muscles and joints, water acts as a lubricant, contributing to the formation of joint fluid and the proper functioning of the musculoskeletal system in general [5-8].

The formula of water is H₂O, and the ratio of relative weights of hydrogen and oxygen in the molecule is 2.0160/16. The amounts released from water by electrolysis of the two gram-hydrogen atoms to one gram-oxygen atom were examined by combining them, the result always being one mole of water, ie 18 g of water (molecular mass M = 18). In terms of percentage, the water content is 11.19% hydrogen and 88.81% oxygen, respectively. Almost all types of chemical bonds are formed by water, this substance frequently performing the specific reactions in organic chemistry: acid-base reactions, redox reactions and complexation reactions; as an effect, there are reactions of hydrolysis or buffering, hydration, catalysis [9].

The drinks generally used by those who exercise, systematically and regularly, mainly contain water, as well as other nutrients and substances, the purpose for which they are consumed being: pleasant taste, source of energy and hydration, fad or the influence of advertisements with public impact [10-13].

The purpose of this study was to identify the types of water and other drinks used for hydration by those who perform movement activities and also to analyze the quality of these beverages. The main objective of the research it was to understand more correctly, what proper hydration entails, what are the factors that must be taken into account in order to maintain good health.

2. Materials and methods

The study was conducted from September 2019 to February 2020 and was in two phases:

A. The initial stage involved the application of a questionnaire in order to identify the main types of drinking water and beverages used by various regular physical activity practitioners. Thus, 80 subjects were interviewed (40 male, 40 female), none of them being a performance athlete. The movement activities they perform in their free time are tennis, jogging, cycling, and various sports games. The age range of the respondents was 22-56 years.

B. The final stage. As a result of the answers received from the subjects, we analyzed the various categories of water and other drinks that they used mainly for the hydration action. In this approach, we used data from various scientific research published in international databases (WoS, Scopus, PubMed, etc.), public data on various products and two devices for measuring water quality: TDS Meter 3 and Tester SMART PH 03. With the help of the first device, we measured the specific conductivity, respectively the combined content of all inorganic and organic substances contained in water, and with the second device, we measured the pH of the water.

3. Results and discussions

The level of electrolytes mentioned in Table 1 indicates that there are differences between the types of beverages analyzed. Of all the electrolytes, it is considered that the most important is sodium because it stimulates the absorption of water and sugar in the small intestine, has a role in maintaining high plasma osmolality and in maintaining the volume of extracellular fluids and stimulating the sensation to drink fluids, so moisturizing [14, 15]. The results of this study show that energy drinks have the lowest amount of sodium. Although, at first glance, these drinks would be best suited for movement activities, they are not the most suitable for proper hydration. In fact, even in the practice of performance sports, it is recommended to consume a larger amount of sodium the longer and more intense the effort. During prolonged physical exertion, 3-4 g can be lost through sweating.

Carbohydrates are important because they provide the body with an important source of energy. It is important that their quantity in liquids is not increased and the most suitable type of carbohydrates should be of the complex type, the variant in which the energy is released slowly, for a longer period, without a disturbance of the glycemia [14, 16]. Drinks that contain sugar (simple carbohydrates), in this case energy drinks, cola drinks and lemonade, can cause gastrointestinal disorders, obesity and reduce the amount of fluid that will be absorbed in the small intestine, ie low hydration.



Among the analyzed drinks, the electrolyte/carbohydrate ratio is favorable for soy drinks, of course as long as it is consumed in optimal quantities for each individual and the type of effort provided. However, a number of authors recommend that still water be consumed mainly for light to medium efforts.

Table 1. Average values of electrolytes and carbohydrates for different types of drinks

The type of drinks	Electrolytes (mg)				Carbohydrates (g)
	Sodium	Potassium	Magnesium	Calcium	
Still water	3.5	0.75	1.31	8.90	0
Sparkling water	3	0.9	3	10	0
Energy drinks	0.2	3	3	13	11.5
Natural orange juice	4	101	5	8	10.4
Lemonade	7	72	7	7	49.89
Soy drinks	73	110	24	23	4.50
Assortments Cola drinks	2	1.5	0	1	10.7

The average of the values is reported per 100 g

The calculated values come from public data about the analyzed products

Table 2. Minimum and maximum values for the purity and pH of drinking water categories

Categories of potable water	Water purity -ppm (mg/L)		pH	
	Min.	Max.	Min.	Max.
Still water	33	250	6.5	9
Sparkling water	180	300	5	6
Potable water from the tap	120	260	6.5	7

Between 0-50: high purity

Between 50-100: general purity

Between 100-300: medium level purity

Over 300: unsuitable values for human consumption

From the comparative analysis of the data in Table 2, we can notice that there is a rather big difference between the minimum and maximum values for still water. Of all the three categories of water, only for still water, the minimum value falls within the water threshold with high purity. A hydration with water with a high level of purity, gives the consumer a great advantage, namely: the water has the property to remove inorganic substances stored in the tissues of our body, which determines the improvement of health. Research that is more recent has shown that the need for minerals is indicated to come largely from food and less from water. Only after being absorbed by plants through their roots, inorganic minerals become organic through the process of photosynthesis, which determines the assimilation into tissues as organic minerals.

Another aspect that emerges from the analysis of the two parameters is that the sparkling water that is commercially available (in Romania) is the weakest in terms of quality, being desirable to be consumed as rarely and in quantities as small. Regarding the pH, the specialists consider that the alkaline water is the most suitable variant of consumption both for maintaining an optimal state of health, slowing down the aging process of cells and as a remedy for the prevention and treatment of some diseases (reflux diseases, stomach diseases, high cholesterol and some type's cancer) [17, 18].

Tap water was measured from several places in Brasov and Bacau County, Romania, which highlights the fact that the quality of tap water is different, preferable for consumption being the one with the highest purity (the lowest values in the table) and with the highest pH.

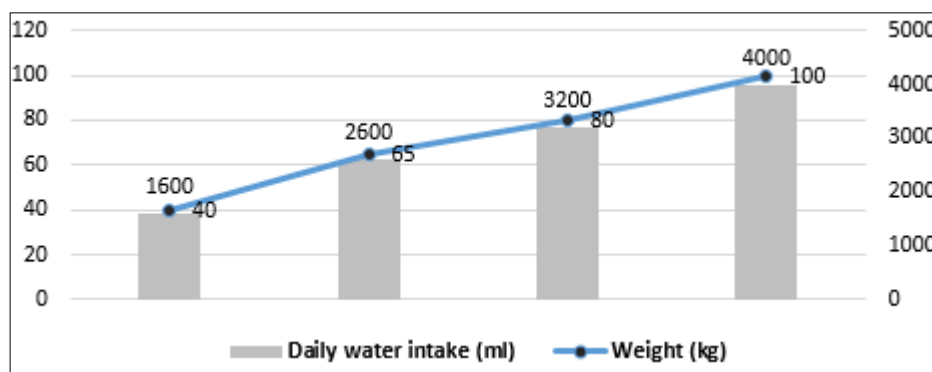


Figure 1. Average intake of water to be ingested daily depending on weight

The results shown in Figure 1 were calculated according to the formula 40 ml water/kilobody/day. The indicated values are average, indicative values, in the calculation of the individual contribution for a certain person; also other factors must be taken into account: age, gender, health status, ambient temperature, level of physical effort.

From the analysis of the data, we can see that the higher the body weight, the higher the amount of water to be consumed. This relationship of direct proportionality is important to be respected, so as not to endanger our health. It is known that an optimal consumption of water contributes to the elimination of toxins and residues from the body and the proper functioning of the heart. Insufficient water intake will force the heart to pump more oxygenated blood to the cells. In such a case, corroborated with the development of motor activities, the force of the heart would be even greater, the state of fatigue settling much faster [19].

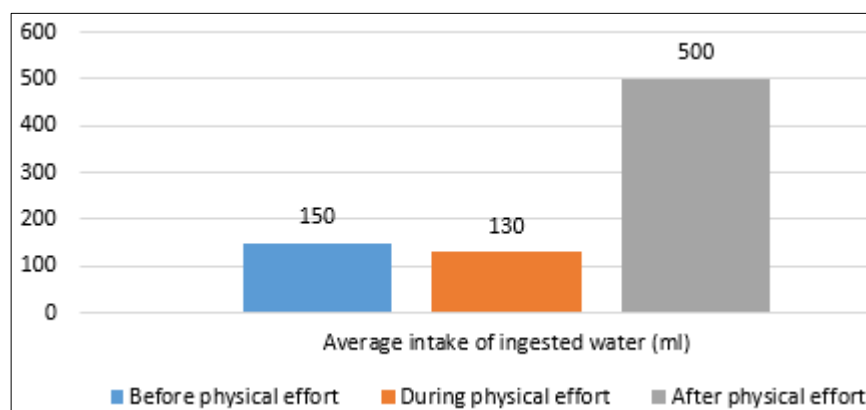


Figure 2. Average intake of water to be ingested before, during and after performing a medium level of physical effort

Water values to be consumed before, during and after physical exertion from Figure 2, are general values, in principle. It should be noted that the amount indicated to be consumed during the effort must be repeated every 15-20 min of effort. These data are important to respect in principle so as not to end up in external situations: dehydration, respectively over hydration. The latter has as effects a dysfunction in the kidneys; these organs can no longer filter too much fluid. This imbalance causes a decrease in the level of sodium in the blood (hyponatremia). As a paradox, excessive hydration has the same effects as insufficient hydration.

4. Conclusions

Hydration is a important aspect that should be done correctly by all those who do regular exercise activities. Proper hydration involves ingesting quantities of liquids by a correct ratio to their own weight and the type of effort provided on the one hand and on the other hand to the quality of water



and other drinks expressed in optimal sodium concentrations, high level of purity, alkaline pH and a low level of simple carbohydrates.

Hydrate properly when performing movement activities does not mean consuming drinks that are not in accordance with the purpose pursued by exercise or as an effort to be apparently easier. It is important to ensure the quantities and quality of fluids that are needed so as not to affect in any way your health and quality of life. In this sense, it is necessary to know the correct chemical composition of these liquids, as well as their meanings in order to optimize their consumption, in terms of purpose, age, level of physical training, weight, etc.

Acknowledgments. Being the cumulative result of the activity submitted by the seven authors for the analysis, systematization and classification of the exposed information, we emphasize the fact that all the seven authors have an equal contribution to the realization of this scientific article. No financial resources were required.

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Manuscript received: 6.07.2020