Differences In Isotonic Beverages Compared To Mineral Water On Blood Pressure, Heart Rate And Sodium In Students Of The Faculty Of Nursing Universitas Prima Indonesia Underwriting Circuit Training

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Abstract.
Circuit training is a training system that can simultaneously improve the overall fitness of the body, namely the elements of power, endurance, strength, agility, speed, and other components of physical condition. This research is an experimental research Pretest-Posttest Control Group Design. The sample in this study were students of the Faculty of Nursing at Prima Indonesia University. The sample numbered 20 people, divided into 2 groups and none of them withdrew. Data processing using the SPSS program version 23. Research time was Wednesday, 14 August 2019 to Monday, 19 August 2019. The results showed that the participants who were given isotonic fluids experienced a significant decrease in systolic blood pressure ($p<0.05$) and heart rate ($p<0.05$) on the first and second days due to body adaptation, while on the third to fifth day the decrease did not occur. significant ($p>0.05$). There was a significant increase in systolic blood pressure ($p<0.05$) and heart rate ($p<0.05$) in participants who were given mineral water. Giving isotonic fluids or minerals does not affect diastolic blood pressure. However, there was an increase in blood sodium levels ($p<0.05$) in participants who were given isotonic fluids, while in participants who were given mineral water there was a decrease in blood sodium levels ($p<0.05$).

Keywords: *Circuit Training, Blood Pressure, Heart Rate and Sodium Levels in The Blood.*

I. INTRODUCTION

The problem of not drinking enough water shows that 50% of people drink less than 5 glasses of water per day. Adolescents and young adults (15-24 years) are a group that experiences a lot of water shortages. Most women only drink 5-6 glasses of water and men drink 6-8 glasses per day, even though the recommendation for drinking water is 8 glasses per day. The most common reason people don't drink enough is because: 1) they don't feel thirsty; 2) forgot to drink; 3) troublesome; 4) don't want to go to the restroom frequently. As many as 70% of the subjects drank after feeling thirsty; even though it must be felt after the body lacks water of around 1% which has the potential to cause disturbances in body function, mood, and cognition [1].Various studies have shown that not drinking enough water has a negative impact on health or increases the risk of various diseases, such as constipation, cramps, kidney stones, urinary tract infections and others. It also has a negative impact on stamina, memory and intelligence. Lack of water can reduce stamina, work productivity and even increase the risk of work accidents. Lack of water 1% of body weight begins to interfere with the work of the brain and thinking ability, and lack of water 2% of body weight causes a momentary decrease in concentration and memory. This will have a negative impact on children's intelligence and education [1].Water is a nutrient element and the main component in the human body. Water as one of the essential macronutrients has several functions, including as a solvent and means of transportation, as a catalyst, lubricant, growth facilitator, body temperature regulator and shock absorber [2].

Body water content differs between humans depending on the proportion of muscle tissue and fat tissue. A body that contains more muscle tissue contains more water. Normally, in one day the body will lose fluids through the kidneys, skin, lungs and feces. To keep the condition and function of body fluids undisturbed, the lost fluids must be replaced. If the body does not get enough water or loses water of about 5% of body weight (in children, adolescents and adults), this condition is known as dehydration [2].Most of the composition of the body is fluid. Water in the body makes up about 50-60% of the total body weight. Water in the body has important functions including transporting nutrients & oxygen into the body's cells, regulating body temperature, helping the digestive process, lubricating joints, and a place for energy

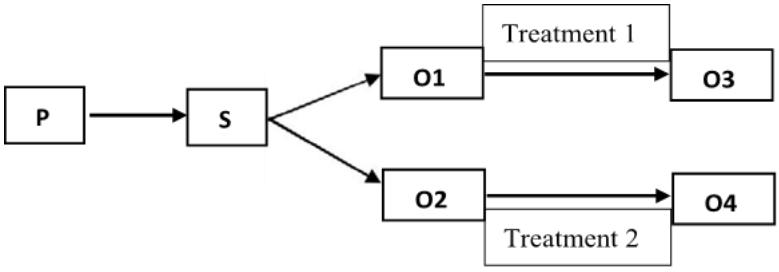
production. Lack of fluid consumption that causes dehydration is harmful to health and makes the body's workload heavier [3].Large amounts of intravenous fluids are often needed to correct the fluid deficit and compensate for blood loss during surgery. Fluids and electrolytes in the body are an inseparable unit. The composition of fluids and electrolytes in the body is regulated in such a way that the balance of vital organ functions can be maintained. Major disturbances in fluid and electrolyte balance can rapidly alter cardiovascular, nervous and neuromuscular function, and the anesthetic provider must have a clear understanding of normal water and electrolyte physiology [4].Fluid and electrolyte requirements are a dynamic process because the body's metabolism requires constant changes in response to physiological and environmental stressors.

Fluid balance is essential for health. With its enormous ability to adapt, the body maintains balance, usually by integrated physiological processes that result in a relatively constant but dynamic cell environment. The body's ability to maintain fluid balance is called "homeostasis" [4]. Electrolytes play an important role in controlling fluid levels, acid-base balance and regulation of neurological and myocardial functions, oxygen delivery and many other biological processes [5].Electrolyte imbalance is a deviation in the serum electrolyte level towards a higher (hyper) or lower (hypo) side leading to adverse effects on the body's systems and serious problems such as seizures and cardiac arrest. Recent studies report that fluid and electrolyte imbalances are associated with increased morbidity and mortality in diseased patients. Research studies show that hyponatremia is the most common, in which hyponatremia patients are associated with disturbances in the mechanism of urine dilution in the kidneys which can cause cell dehydration and damage to the central nervous system [6].In general, people will drink plain water during exercise, but this will cause hyponatremia because the amount of water and sodium becomes unbalanced. Some people prefer natural alternatives because sports drinks contain fructose, maltodextrin, sweeteners, as well as artificial essences and added electrolytes that can interfere with muscle contraction. High fructose can cause gastrointestinal disturbances and result in osmotic diarrhea [7].

II. METHODS

Research design

The research design used was an experimental pretest-posttest control group design.



Information:

P = Population

S = Sample

O1 = Observation of group 1, before getting an isotonic drink

O2 = Observation of group 2, before getting mineral water

O3 = Observation of group 1, after getting a drink isotonic

O4 = Observation of group 2, after getting mineral water

Treatment 1 = Giving isotonic fluids

Treatment 2 = Giving mineral water

The research location is in the Nursing Field of Prima Indonesia University. Research time is from Wednesday, 14 August 2019 to Monday, 19 August 2019. In this study the target population was all students of the Faculty of Nursing, Universitas Prima Indonesia. The reachable population in this study were students of the Faculty of Medicine, Universitas Prima Indonesia, aged 21-24 years. The research sample is 20 people. The research sample was obtained from a population that met the following criteria Inclusion Criteria Age 21-24 Male sex Electrolyte Profile: 130-143 mEq/L Healthy body and no physical disabilities Sleep

time ± 8 hours/day. Exclusion criteria Subjects were not included as a sample of the study or the exclusion criteria were smokers. Drop Out Criteria Subjects were not included as research samples if they were sick during treatment or during examination.

Table 1. BMI Threshold Categories for Indonesia [8]

Classification	Body Mass Index (BMI) (kg/m2)
Underweight	IMT < 18,5
Normal	IMT ≥ 18,5 - < 24,9
Overweight	IMT ≥ 25,0 - < 27
Obesity	IMT ≥ 27,0

Data Collection Technique

Determination of the sample was carried out in the following way. The population was students of the Faculty of Nursing, Prima Indonesia University, a sample was selected according to the inclusion and exclusion criteria. In a simple random manner, a lottery was held by making 10 pieces of paper rolls containing codes 1 and 2, then all the paper rolls were put into a box, then shuffled. The sample takes the roll paper one by one until the number of samples. Samples that get code 1 are put into group 1 (isotonic liquid); code 2 are put into group 2 (mineral water).

Research Variable

The independent variables are isotonic drinks and non-isotonic drinks, the dependent variables are blood pressure, heart rate, and sodium levels in the blood, the controlled variables are age, body mass index, electrolyte profile, electrocardiogram, physical activity in the form of badminton, random variables, namely ambient temperature, and humidity.

Perational Definition & Tools and Materials

The isotonic drink used in this study was a 300 ml pack and given 30 minutes before doing circuit training. The mineral water drink used is ordinary mineral water with 300 ml packaging given 40 minutes before doing circuit training, circuit training exercises are carried out within ± 30 minutes, and have 6 sports posts. The ages of the people trying in this study were 21-24 years. Body mass index (BMI) is a simple tool to measure the nutritional status of adults (age 18 and over), especially with regard to underweight and overweight. The researcher determined the recovery time. TD, HR, Sodium before conducting circuit training activities and HR, TD, Sodium after conducting circuit training activities. Taking sodium levels is used by taking a blood sample and bringing it to the laboratory for examination.Research materials are isotonic drinks, mineral water while research tools are sphygmomanometers, stethoscopes, pulse oximeters, informed consent forms, writing instruments and value recording forms, documentation tools.

Research Implementation

Circuit training is a training model that involves a series of different exercises performed sequentially and continuously during one round or circuit. This means choosing specific exercises and moving quickly from station to station to maximize effectiveness and time efficiency [9]. Short-term training programs take less than one year. The short-term training program according to Bompa terminology is divided into 2 training cycles namely; (a) Microcycle is the shortest cycle in training periodization, its duration ranges from 5 to 10 days, but in terminology regarding the periodization of this microcycle, it is generally one week. (b) The macro cycle, in the macro cycle methodology is expressed as a training phase with a time between 2-6 weeks or 2-6 micro cycles. Short-term periodization is generally divided into training phases towards competition, this periodization is divided into general preparation phases, special preparation phases, pre-competition phases, competition phases and transition phases [9]. This study used the circuit training method, from the explanation the researcher conducted a short-term training program, using a micro cycle, namely the duration of the circuit training exercise was 5 days. The circuit training exercise that will be carried out consists of 6 posts, namely Post 1 Sit Up, post 2 Push-Up, post 3 Jumping Jack, post 4 Running, post 5 Shuttle Run, Post 6 Squat Jump [9].

Research Procedure & Data analysis

Prepare the tools and materials to be used. Samples are selected according to inclusion and exclusion criteria. Samples are asked to warm up for 10 minutes. After heating, the sample's blood pressure will be

checked using a sphygmomanometer and stethoscope and pulse will be checked using a pulse oximeter. And take blood using an intravenous syringe to check sodium levels in the blood. Then the samples will be divided into two groups, namely group 1 will be given isotonic drinks and group 2 will be given mineral water. Ten minutes after being given isotonic drinks and mineral water, the samples will be taken. ask to start the activity starting from post 1 to post 6 (each post will be carried out for 5 minutes). Then the sample's blood pressure will be checked using a sphygmomanometer and stethoscope and pulse will be checked using a pulse oximeter. And take blood using a syringe in the intravenous to check sodium levels in the blood. Data collection. This activity is carried out for 5 days in group 1 and group 2.The data obtained were analyzed using the following steps. Descriptive analysis of the research subjects included age, weight, height, resting pulse and activity pulse. Using SPSS with the paired t-test method.

III. RESULT AND DISCUSSION

Research Result

Table 1. Effect of Isotonic Drinks on Systolic Blood Pressure

Day	Parameter	Mean	Std. Deviation	Sig. (2-tailed)
1	Systolic Blood Pressure Pretest Posttest Systolic Blood Pressure	126,00 119,00	5,164 5,676	,001
2	Systolic Blood Pressure Pretest Posttest Systolic Blood Pressure	126,00 119,00	5,164 5,676	,001
3	Systolic Blood Pressure Pretest Posttest Systolic Blood Pressure	126,00 120,00	5,164 8,165	,111
4	Systolic Blood Pressure Pretest Posttest Systolic Blood Pressure	126,00 120,00	5,164 8,165	,111
5	Systolic Blood Pressure Pretest Posttest Systolic Blood Pressure	120,00 125,00	4,714 7,071	0,96

Table 2. Effect of Mineral Water on Systolic Blood Pressure

Day	Parameter	Mean	Std. Deviation	Sig. (2-tailed)
1	Systolic Blood Pressure Pretest Posttest Systolic Blood Pressure	118,00 120,00	7,888 4,714	,443
2	Systolic Blood Pressure Pretest Posttest Systolic Blood Pressure	117,00 123,00	6,749 6,749	,051
3	Systolic Blood Pressure Pretest Posttest Systolic Blood Pressure	118,00 128,00	7,888 4,216	,008
4	Systolic Blood Pressure Pretest Posttest Systolic Blood Pressure	118,00 128,00	7,888 4,216	,004
5	Systolic Blood Pressure Pretest Posttest Systolic Blood Pressure	113,00 122,00	6,749 9,189	,010

The results of the analysis proved that by administering isotonic fluids, there was a significant decrease in systolic blood pressure on the first and second days ($p<0.05$), while on the third to fifth day ($p>0.05$) the decrease in systolic blood pressure was not significant, so that it can be it was concluded that the administration of isotonic fluids can cause a decrease in systolic blood pressure. The results of the analysis proved that the administration of mineral water caused an increase in systolic blood pressure, although on the first and second days the results were not significant ($p>0.05$). But on the third to fifth day there was a significant increase in systolic blood pressure ($p <0.05$).At rest (sitting or lying down) the systolic blood pressure (measured at the upper arm) is usually <130 mm Hg and the diastolic blood pressure is <85 mm Hg for >18 years of age [10]. At the time of exercise, systolic blood pressure increased > 185 mmHg even though the diastolic blood pressure remained unchanged. Higher blood pressure during physical activity is necessary to meet the additional demands of working muscles.

Exercise can reduce blood pressure not only because of reduced body weight, but also because of how blood pressure is generated [11].Blood pressure is determined by 2 things, namely the amount of blood pumped by the heart per second and the resistance faced by the blood in doing its job through the arteries. Exercise can cause the growth of new capillaries and new blood vessels. Thus things that impede blood flow can be avoided or reduced which means lowering blood pressure. Although the heart's ability to do its work increases through exercise, the effect of reducing resistance is to provide a significant reduction in blood pressure [12]. After exercise is over, blood pressure may temporarily drop below normal, possibly due to the accumulation of metabolites that keep the muscle vessels dilated for brief periods. However, as soon as blood pressure returns to pre-exercise levels, the heart rate returns to normal more slowly [13].These results are in line with research conducted by Dariusz Nowak et.al., where The results showed that before giving isotonic drinks, systolic blood pressure was 123, then after giving isotonic drinks, systolic blood pressure decreased to 122.2 with a sig. : 0.809 (p>0.05) [14]. Meanwhile, the results of systolic blood pressure given mineral water are in line with research conducted by Trahair et.al., where the results of the study experienced a significant increase in systolic blood pressure (p <0.05) in subjects with Postprandial Hypotension (PPH) [15].

Table 3. Effect of Isotonic Drinks on Diastolic Blood Pressure

Day	Parameter	Mean	Std. Deviation	Sig. (2-tailed)
1	Diastolic Blood Pressure Pretest Posttest Diastolic Blood Pressure	77,00 79,00	4,380 3,162	,343
2	Diastolic Blood Pressure Pretest Posttest Diastolic Blood Pressure	77,00 78,00	4,830 4,216	,678
3	Diastolic Blood Pressure Pretest Posttest Diastolic Blood Pressure	78,00 80,00	4,216 ,000	,168
4	Diastolic Blood Pressure Pretest Posttest Diastolic Blood Pressure	79,00 79,00	3,162 3,162	1,000
5	Diastolic Blood Pressure Pretest Posttest Diastolic Blood Pressure	80,00 79,00	,000 3,162	,343

Table 4. Effect of Mineral Water on Diastolic Blood Pressure

Day	Parameter	Mean	Std. Deviation	Sig. (2-tailed)
1	Diastolic Blood Pressure Pretest Posttest Diastolic Blood Pressure	79,00 79,00	4,830 3,162	1,000
2	Diastolic Blood Pressure Pretest Posttest Diastolic Blood Pressure	78,00 78,00	4,830 4,216	1,000
3	Diastolic Blood Pressure Pretest Posttest Diastolic Blood Pressure	77,00 78,00	4,216 ,000	,343
4	Diastolic Blood Pressure Pretest Posttest Diastolic Blood Pressure	79,00 77,00	3,162 3,162	,343
5	Diastolic Blood Pressure Pretest Posttest Diastolic Blood Pressure	78,00 76,00	,000 3,162	,343

Table 5. Effect of Isotonic Drinks on Heart Rate

Day	Parameter	Mean	Std. Deviation	Sig. (2-tailed)
1	Pretest Heart Rate Posttest Heart Rate	96,30 87,30	9,262 10,253	,029
2	Pretest Heart Rate Posttest Heart Rate	96,30 87,20	9,262 10,130	,027

3	Pretest Heart Rate Posttest Heart Rate	87,00 84,40	12,454 10,824	,615
4	Pretest Heart Rate Posttest Heart Rate	86,90 84,40	12,679 10,824	,632
5	Pretest Heart Rate Posttest Heart Rate	86,90 79,70	12,351 12,410	,154

Table 6. The Effect of Mineral Water on Heart Rate

Day	Parameter	Mean	Std. Deviation	Sig. (2-tailed)
1	Pretest Heart Rate Posttest Heart Rate	96,60 96,50	5,358 4,327	,970
2	Pretest Heart Rate Posttest Heart Rate	86,70 85,40	12,482 11,626	,799
3	Pretest Heart Rate Posttest Heart Rate	92,00 95,50	7,860 7,184	,040
4	Pretest Heart Rate Posttest Heart Rate	91,50 95,50	7,442 7,184	,019
5	Pretest Heart Rate Posttest Heart Rate	81,90 92,90	15,132 12,414	,019

The results of the analysis proved that by administering isotonic fluids, there was a significant reduction in heart rate on the first and second days ($p<0.05$), while on the third to fifth days ($p>0.05$) there was a decrease in heart rate but not significant, so it can be concluded that administration of isotonic fluids can cause a decrease in heart rate. The results of the analysis proved that giving mineral water caused an increase in heart rate, even though on the first and second days the results were not significant ($p> 0.05$). But on the third to fifth day there was a significant increase in systolic blood pressure ($p <0.05$).The heart rate is primarily controlled by the sympathetic innervation which increases the frequency while the sympathetic nerves decrease it. An increase or decrease in the frequency of the pacemaker action potential changes. The influence of the sympathetic nerves on the heart muscles causes changes in the rhythm of the heart rate. The influence of the sympathetic nerves on the heart muscles causes stronger contractions without having to increase the length of the muscle fibers and causes more blood to be pumped out of the heart. In other circumstances, the sympathetic nerves cause the contents of the end of systole to be less than normal. This situation is called inotropic action of the sympathetic nerves on the heart (factors that can increase the strength of heart contractions are called positive inotropes and those that decrease them are called negative inotropes). While the increase in heart rate rhythm is said to be chronotropic work [16].The response to exercise involving isotonic muscle contractions is an immediate increase in heart rate. In addition, there is a net decrease in total peripheral resistance due to vasodilation in the exercising muscles. As a result, systolic blood pressure increases moderately.

Meanwhile, diastolic blood pressure does not change or decrease. Cardiac output increases during isotonic exercise to rates that can exceed 35 liters per minute, an amount equivalent to an increase in O2 consumption. This increase is caused by an increase in heart rate and stroke volume, the heart muscle contracts more forcefully and ejects more end-systolic volume of blood in the ventricles. The maximum heart rate during exercise decreases with age. In adults the heart rate exceeds 195 beats per minute and in the elderly the increase is even less [13].At light and moderate work, heart rate and lactate levels soon become new and constant values (no fatigue) whereas maximal work must be stopped after a while because the heart cannot maintain the high performance required of it. A trained athlete has more mitochondria in his muscles, enabling him to break down more glucose through oxidative pathways. This is the main reason why blood lactate increases only then less than in an untrained person. Exercise increases stroke volume and tidal volume, which results in very low heart and respiratory rates during rest, but allows for higher cardiac output and ventilation rates during exercise than untrained people [16].In both resting and exercise conditions,

athletes who train have a larger stroke volume and lower heart rate than people who are not trained. Changes that occur in skeletal muscles with exercise are an increase in the number of mitochondria and enzymes that play a role in oxidative metabolism.

There is an increase in the number of capillaries, with better distribution of blood to the muscle fibers. The increase in blood flow to the muscles becomes lower, the heart rate and cardiac output increase less compared to untrained people [13].Endurance (aerobic) exercise can lower resting heart rate. If the resting pulse before exercise is measured 80 times per minute. In each week of practice there will be a decrease in pulse rate 1 time per minute each week. After 10 weeks of regular, moderate-intensity aerobic exercise, the resting heart rate will decrease from 80 to 70 beats per minute. The mechanisms responsible for this decrease are not fully understood, but exercise causes parasympathetic activity and decreased sympathetic output of the heart [17].These results are in line with research conducted by Hagi, where the results of the study of pulse frequency before and after consumption of isotonic drinks were 164 x/day minutes and 103.47 x/minute after being analyzed by statistical tests significantly different p=0.015 (P≤0.01) [18].Meanwhile, the results of being given mineral water are in line with research conducted by Hermawan et.al., where the results of the experimental group given mineral water on the initial test was 74.13 with an SD of 2.875 and the final test was 76.60 with an SD of 4.517. And obtained t count 1.784 and the value α = 0.085> 0.05 [19].

Table 7. The Effect of Isotonic Drinks on Sodium

Day	Parameter	Mean	Std. Deviation	Sig. (2-tailed)
1	Pretest Sodium Posttest Sodium	137,00 138,60	1,567 1,578	,001
2	Pretest Sodium Posttest Sodium	137,22 138,56	,833 ,882	,002
3	Pretest Sodium Posttest Sodium	137,20 138,70	,789 ,949	,001
4	Pretest Sodium Posttest Sodium	137,70 138,60	1,567 1,578	,001
5	Pretest Sodium Posttest Sodium	136,80 139,00	2,150 1,155	,001

Table 8. Effect of Mineral Water on Sodium

Day	Parameter	Mean	Std. Deviation	Sig. (2-tailed)
1	Pretest Sodium Posttest Sodium	139,90 138,60	,738 1,897	,057
2	Pretest Sodium Posttest Sodium	139,90 138,60	,738 1,897	,057
3	Pretest Sodium Posttest Sodium	139,70 138,40	,949 1,265	,002
4	Pretest Sodium Posttest Sodium	139,70 138,60	,949 ,966	,001
5	Pretest Sodium Posttest Sodium	140,30 138,80	,823 1,135	,000

The results of the analysis prove that by administering isotonic fluids, there is a significant increase in sodium levels in the blood on the first day to the fifth day. Thus, sodium levels in the blood can be increased by giving isotonic drinks. The results of the analysis proved that the administration of mineral water after the pretest and posttest exercises resulted in a significant decrease in blood sodium levels on heart rate, although on the first and second days the results were not significant (p>0.05). But on the third to fifth day there was a significant increase in systolic blood pressure (p <0.05). Thus, giving mineral water can reduce sodium levels in the blood.Sports drink (isotonic drink) is a drink which contains water, nutrients and

solutes to support ergogenic. Usually rich in carbohydrates, as the most efficient source of energy, which is important in maintaining exercise and sports performance. Sports drinks contain electrolytes (minerals such as chloride, calcium, magnesium, sodium and potassium), which, along with body fluids, are lost/reduced by exercise and sweating. Compared to plain water, drinks containing carbohydrates and salt (electrolytes) can improve performance when consumed before or during high-intensity exercise that lasts at least one hour [1].Sodium as the main cation in extracellular fluid has the most role in regulating fluid balance. If the body excretes a lot of sodium while its intake is limited, a state of hydration occurs with a lack of sodium. If the lack of water and sodium in the plasma cannot be maintained, circulatory failure occurs [1]. So that there was a significant increase in isotonic administration compared to those given mineral water. This happens because sports drinks contain electrolytes that can replace sodium released by sweat itself [5].

IV. CONCLUSION

Based on the results of research and analysis of data on the effect of isotonic fluids and non-isotonic fluids on the recovery time of blood pressure and heart rate after exercise, drinking isotonic fluids will reduce systolic blood pressure, on the first and second day the decrease is significant ($p < 0.05$), this was due to the body's adaptation to exercise, but on the third to fifth day the systolic blood pressure decreased not too significantly ($p > 0.05$) so it was still good for the body.Based on the results of research and analysis of data on the effect of isotonic and non-isotonic fluids on the recovery time of blood pressure and heart rate after exercise, drinking mineral water will increase systolic blood pressure, on the first and second day, the increase is not very significant (p> 0, 05), but on the third to fifth day the systolic blood pressure experienced a significant increase ($p < 0.05$) this happened because the body needed more oxygen resulting in increased blood pressure so it is still good for the body.Meanwhile, drinking isotonic fluids or mineral water will not have an effect on diastolic blood pressure. And drinking isotonic fluids will reduce the value of the heart rate, on the first and second day the decrease is significant, this is due to the body's adaptation to exercise, but on the third to fifth day the systolic blood pressure decreases not too significantly so it is still good for the body. Drinking mineral water will increase the value of the heart rate, which is getting more and more significant every day so it is good for sports activities or activities that produce excessive sweating.

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