Effect of hydration on blood pressure

Introduction

Water is the key to all life; without it, life as we know it would not exist. So it is natural to believe that hydration should have an effect on blood pressure and heart rate, considering our heart is also one of the keys to our life as humans. So we will be testing what affect hydration has on blood pressure and heart rate, if any. Blood pressure is the pressure of the blood within our arteries. The measurement is recorded as the systolic pressure (pressure when heart contracts) over the diastolic pressure (pressure when the heart is relaxed). (Weedman, Sokoloski 2009)

A study was done at Franz-Volhard Clinical research center that examined how water drinking affected blood pressure in the body. The results showed that drinking 500mL of water increased patients' blood pressure and also increased heart rate (Schroeder 2002). Although it was only a slight increase, it still had an affect on the pressure and heart rate.

Jens Jordan also did a study on how water affects blood pressure and found that the older the patient was the more of an effect drinking water had on blood pressure. In fact, in some of the younger patients drinking water had no effect at all. However, when the water did have an effect it increased blood pressure every single time. Some of the reasons for this increase, Jordan describes, are because water and plasma have different osmolarities (concentration of solute vs. solution), the pressure in the blood increases. Also, water may cause different plasma concentrations in the blood which would also cause an increase in blood pressure (Jordan 2002).

Rats and humans are very alike organisms. Our bodies both function and are made similarly. So when David Belanger and Samuel M. Feldman did a study on the effects of water deprivation on rats, we can predict that something similar may happen in humans. The rats' heart rates decreased the longer they were dehydrated (Belanger and Feldman 1962). The study did not test what hydrating the rats would do, but since the heart rates decreased without water, it is possible that they would increase with water.

One reasonable explanation of why dehydration affects blood pressure is due to the tightening of blood vessels. The volume of blood in the blood vessels and veins of the body will begin to lessen when water is drawn from them. As a result, the vessels and veins will contract in order to stay full of blood (otherwise there is extra space, leaving room for gas to build up). This contracting results in high tension, or high blood pressure (Healthy-water-best-filters).

I hypothesize that hydration will affect blood pressure and heart rate. I predict that the blood pressure and heart rate will increase. The significance of this experiment is determining how hydration affects blood pressure and heart rate. It is important to know this because high blood pressure is a dangerous condition, and many people suffer from it. If hydration can affect blood pressure (and heart rate) in a good way, it may produce many ways to help keep blood pressure and heart rate at a healthy state.

Materials and Methods

First, the variable to be tested (hydration) was decided by the class and a question to test was determined. The dependent variable was blood pressure and heart rate (beats per min). The independent variable was hydration (and time). Basal readings (resting blood pressure and heart rate) for each student were used from the last experiment. Each student did not drink any water over the duration of the class (about 2. 5 hours), and at the end of class, each student drank roughly 16oz of water. Each person recorded their blood pressure and heart rate at time zero by using their basal BP and HR from the past experiments. Immediately after drinking the water, a partner began timing the other partner. Every three minutes each partner measured their partner’s blood pressure (systolic/diastolic pressure) and heart rate (beats per min) using a digital sphygmomanometer (which expressed both heart rate and blood pressure). A measurement was taken every three minutes for 12 minutes. There were 13 groups who gathered data, so 26 total students’ data was obtained and put into excel. Averages, T-Tests, and ranges were then attained and analyzed. (Weedman, Sokoloski 2009)

Results

After all 26 students in the class drank about 16oz of water, each found a partner and started to record the blood pressure and heart rate of each other every 3 minutes for 12 minutes. The data for each student was obtained and analyzed in an excel spreadsheet.

The basal readings (resting rate) for blood pressure (systolic/diastolic pressure) for all 26 students ranged from 83/57 to 158/105. After every student took three basal readings, the averages for each basal reading were taken, and all three averages were averaged at 108/69. The blood pressures at time zero ranged from 91/58 to 175/134. After the outliers were removed, the average for time zero was 117/74. At 3 minutes, the blood pressures ranged from 86/63 to 157/117 and the average was 111/69 after outliers were removed. At 6 minutes, the blood pressures ranged from 85/52 to 150/75 and the average was 109/70 after outliers were removed. At 9 minutes, the blood pressures ranged from 91/53 to 140/80 and the average was 116/75 after outliers were removed. At 12 minutes, the blood pressures ranged from 91/59 to 137/69 and the average was 113/70 after outliers were removed. After performing a T-Test, we can determine that the data is significant (the result of the test was 0. 33). (Table 2)

Graph 2 illustrates how the systolic and diastolic pressures didn't change over time. After drinking 16oz of water, the blood pressure was not affected at all. The slope of the trendline for average systolic pressure is -0. 1. We can determine that this is extremely close to zero. It's not enough of a slope to say that the systolic pressure decreased at all. The slope of the trendline for average diastolic pressure is -0. 07. Again, this is close enough to zero to determine that there was no change in diastolic pressure.

The heart rate basal readings for all 26 students ranged from 53 beats per minute (bpm) to 122 bpm. The overall average basal reading for heart rate was 76. 57 bpm. At time zero, the heart rates ranged from 44 bpm to 116 bpm and the average was 69. 5 bpm after outliers were removed. At 3 min, the heart rates ranged from 52 bpm to 106 bpm and the average was 67. 25 bpm once outliers were removed. At 6 min, the heart rates ranged from 51 bpm to 108 bpm and the average was 66. 3 bpm once the outliers were removed. At 9 min, the heart rates ranged from 55 bpm to 116 bpm and the average was 68. 67 bpm once outliers were removed. At 12 min, the heart rates ranged from 42 bpm to 100 bpm and the average was 69. 33 bpm once outliers were removed. (Table 1)

Graph 1 illustrates the changes in the heart rate over the 12 minutes. From 0 to 6 minutes, the heart rate decreases by 3. 2 bpm, but from 6 to 12 minutes, the heart rate increases by 3. 03 bpm. However, since the average basal reading was 76. 57 bpm, we can see that after drinking water, the heart rate immediately decreased by 7. 07 bpm, and didn't recover after the 12 minutes. Since we didn't measure recovery rate, we don't know how long it took the body to recover.

Discussion

I hypothesized that hydration would affect blood pressure and heart rate. I predicted that hydration would cause the blood pressure and heart rate to increase. The data did not completely support my hypothesis and prediction. Hydration did not affect blood pressure, but it did affect heart rate.

Graph 2 illustrates that once students drank 16oz of water their blood pressure was not affected. The slopes of both of the trendlines for systolic and diastolic pressures were extremely close to zero, showing that the blood pressures did not change due to hydration. Although the pressures increased a bit from the basal readings, it still follows the trend of the graph, and would not affect the trendlines. So we determine that hydration did not affect blood pressure.

Graph 1 illustrates that heart rate was affected by hydration. From time zero to 6 minutes, the average heart rate decreased by 3. 2 bpm. From 6 to 12 minutes, the heart rate increased by 3. 03 bpm. These increases and decreases of the heart rate are very close to each other. If we measured heart rate longer, we would be able to determine if this was a pattern or not. With the amount of data we have, it’s hard to determine if this is a significant increase and decrease. However, from the average basal reading of 76. 57 bpm (Table 1) to the reading at time zero, there was an average decrease of 7. 07 bpm. Compared to the other decrease in the graph, this is a much larger one. So we can conclude that hydration does affect heart rate, but only for a brief period of time. It decreases heart rate immediately, but after about 6 minutes, the heart rate begins to increase again. We can’t determine if the heart rate is recovering because we didn’t measure until the rate completely recovered. So we can only conclude from our data that hydration decreases heart rate for about 6 minutes, and then it begins to recover.

An alternative hypothesis for the effect of hydration on blood pressure and heart rate would be that it would not affect blood pressure, and it would affect heart rate. The results of the study conducted at Franz-Volhard Clinical research center do not match the results we got in our experiment. They discovered that hydration increased both blood pressure and heart rate (Schroeder 2002). Our study showed that hydration does not affect blood pressure, but it does increase heart rate (for a certain period of time). Jens Jordan’s study, however, supports our results. In some of the younger patients in his study, hydration had no effect on blood pressure. But in the older patients, blood pressure increased (Jordan 2002). Since the patients of our experiment are all young, our results match Jordan’s. The study done my David Belanger and Samuel M. Feldman was conducted with rats, not humans and was the effect that dehydration has on heart rate. Their results showed that the longer the rats were dehydrated, the more the heart rates decreased (Belanger and Feldman 1962). I predicted that since the heart rates decreased without water, they would increase with water. Since the experiments and variables were a little different, it’s hard to compare the results of our experiment with theirs. But, my prediction that was based on their experiment was not supported by our data.

I have identified several weaknesses in our experimental setup. If the amount of time allowed to measure the blood pressure and heart rate were extended, we could have determined when the blood pressure and heart rate recovered, and that would have helped with the analysis of our data immensely-especially the heart rate. We may have been able to determine if the heart rate actually did decrease, or if it was just a pattern that the body and heart have naturally. So recovery time would have helped with the significance of our data, as well as the analysis. Also, our data might have been more accurate with a larger group of people. More people would have solidified our data as more accurate.

Works Cited

Belanger, David, and Samuel M. Felman. 1962. “ Effects of water deprivation upon heart rate and instrumental activity in the rat.” Journal of Comparative and Physiological Psychology 55.

“ Dehydration And Blood Pressure Are Linked. Treat HBP with Water!” Dehydration symptoms= Sickness. Chronic Dehydration, Treatment, Hydration. 31 Jan. 2010. .

Jordan, Jens. 2002. “ Acute effect of water on blood pressure.” Mini-Symposium: Review Article.

Schroeder, Christoph, Victoria E. Bush, Lucy J. Norcliffe, Friedrick C. Luft, Jens Tank, Jens

Jordan, and Roger Hainsworth. 2002. “ Water Drinking Acutely Improves Orthostatic Tolerance In Healthy Subjects.” Clinical Investigation and Reports.

Weedman, Donna, and Erica Smith Sokoloski. Biology of Organisms: A Laboratory Manual for LIFE103. Vol. 5E. Mason: Cengage Learning, 2009.