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Article

Decreasing heart rate after consuming caffeine

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SUMMARY

In this study, we sought to answer the question "how can we decrease heart rate after drinking caffeine?" To find ways to help/boost the heart rate recovery after drinking caffeine. Hypotheses tested are taking a walk (1), deep breathing (2), and drinking water (3). After testing each hypothesis, we found that all methods results in a decrease in heart rate. However, only deep breathing was able to reduce heart rate while also decreasing side effects (dizziness, lightheadedness, etc). People who drank caffeine and faced either heart rate increase or side effects (dizziness/ lightheadedness, etc) could perform the methods on themselves to prevent either heart rate increase or side effects. Results of each method were different, and the recommended method is taking a walk since after applying, it decreased heart rate without side effects.

INTRODUCTION

Today, over 1 billion people worldwide drink coffee daily (4). However, the health effects of drinking coffee are often ignored. A recent study found that the average American drinks 3.1 cups of coffee per day (5), which equals 294.5 mg of caffeine (6). Caffeine affects everyone, regardless the age, but it is different from one person to another depending on the amount of caffeine consumed and the person itself. Caffeine may cause stomach problems (7), heart problems (8), and many other problems in the future if consumed in large amounts. As experts found, effects that may appear after drinking caffeine are increase in heart rate (9), lightheadedness, dizziness (10), and other symptoms that are different from one person to another. Symptoms may affect the person mentally and physically throughout the day. Three different hypotheses walking, breathing deeply, and drinking a moderate amount of water were tested to determine if they can decrease the heart rate after drinking caffeine and to see if they can help in avoiding any effects. Different studies have shown that the three selected methods have different effects on the heart rate (1,2,3). These methods were tested to find if they can help heart rate recovery after drinking caffeine. Heart rate decreases over time after drinking caffeine (13) but this reduction in heart rate may be slower without the addition of these methods. When these methods were applied the heart rate decreased, and they helped in the recovery of the side effects that appeared. In other words, these methods boosted the heart rate recovery after drinking caffeine and the recovery of side effects such as dizziness.

Table 1

Trial Number	Heart Rate Before Drinking Caffeine	Heart Rate After Drinking Caffeine	Heart Rate After Walking (Method 1)
1	85 ±0	113.5 ±4.27	87 ±0
2	78 ±0	103.3333 ±2.8	81.5 ±4.8
3	92 ±0	115.5 ±4.024	89 ±1.6
4	71 ±0	96.5 ±4.5	81 ±1.6

Table 1: Heart rate before drinking caffeine, after drinking caffeine, and after walking (method 1). Table shows all four trials with the three measurements for each.

Table 2

Trial Number	Heart Rate Before Drinking Caffeine	Heart Rate After Drinking Caffeine	Heart Rate After Deep Breathing (Method 2)
1	77 ±1.6	103 ±3.5	82.5 ±2.5
2	92 ±0	112.5 ±4.4	96 ±2.7
3	75 ±0	97.5 ±2.71	81.5 ±2.5
4	71 ±2.71	91.5 ±2.5	79 ±4.4

Table 2: Heart rate before drinking caffeine, after drinking caffeine, and after deep breathing (method 2). Table shows all four trials with the three measurements for each.

Table 3

Trial Number	Heart Rate Before Drinking Caffeine	Heart Rate After Drinking Caffeine	Heart Rate After Drinking Water (Method 3)
1	81 ±1.6	100.5 ±4.9	78.5 ±4.42
2	71 ±0	109.5 ±7.3	76.5 ±3.20
3	75 ±0	103 ±3.31	82 ±2.44
4	74 ±0	104.5 ±7.8	72.5 ±2.5

Table 3: Heart rate before drinking caffeine, after drinking caffeine, and after drinking water (method 3). Table shows all four trials with the three measurements for each.

RESULTS

Effects of walking, breathing, and water consumption were evaluated to determine whether heart rate can be lowered following caffeine consumption. Each method four times were evaluated to determine whether results are

significant. Each of the three methods (walking, breathing and drinking water) were four times each after drinking caffeine, that is, we performed four trials for each of the three methods one person. First method, walking (6:33 minutes), was tested and the heart rate decreased from 113.5 ±4.27 to 87 ±0 (bpm) (**Figure 1**), and the side effect that disappeared is dizziness while feeling of having fast heartbeats still appeared (**Table 4)**. Similarly, the second method, deep breathing (five minutes), decreased the heart rate from 103 ±3.5 to 82.5 ±2.5 bpm (**Figure 2**), and the side effects that disappeared are dizziness and having fast heartbeats (**Table 4**). Finally, the third method, drinking water (660 ml of water), decreased the heart rate from 100.5 ±4.9 to 81 ±1.6 bpm (**Figure 3**), and the side effects that disappeared are none while dizziness and having fast heartbeats still appeared (**Table 4**).

DISCUSSION

Caffeine was consumed, then three different methods were tried to decrease heart rate. All three methods decreased heart rate, but each method decreased heart rate to a different degree. More effort was put into each method by each subject, the more the heart rate decreased (11). For example, walking method decreased an average of 32 beats per minute, deep breathing decreased an average of 26 beats per minute, and drinking water decreased an average of 30 beats per minute. But the effort didn't affect side effects that appear after drinking caffeine. Even though the heart rate decreased, the side effects of caffeine still appeared, but not for all methods. The more subjects relaxed, the less subjects pressed themselves (as relaxation occurred, pressure became less). Side effects did not appear, such as dizziness and fast heartbeats, which is a feeling that your heart rate is beating too fast. (12). For example, subject had feeling of having fast heartbeats still appeared after walking, but dizziness disappeared as (**Table 4**). This because walking method relaxes subjects, but not that much. Additionally, deep breathing method was the best, because it was relaxing the most. All side effects disappeared after deep breathing, (**Table 4**). Finally, subject had feeling of having fast heartbeats and dizziness appeared after drinking water (**Table 4**). This was likely due to not having ability to drink water after drinking caffeine, so it was not relaxing at all. We conclude by recommending that the side effects of caffeine, such as dizziness and high heart rate, could be reduced by the deep breathing method because it both decreased heart rate and helped prevent side effects. We tested this to help people find the best way to decrease heart rate immediately and any side effects after drinking caffeine.

Table 4

Methods	Dizziness	Fast Heart Beats	Other Side Effects
Walking	No	Yes	No
Deep Breathing	No	No	No
Drinking Water	Yes	Yes	No

Table 4: Side effects shown after applying each of the three methods. Table shows all three side effects present in the whole experiment, and we answered by yes or no for each method. (*Fast Heart Beats is a feeling that your heart is bumping too fast).

Heart rate recovery after caffeine ingestion can take up to six hours (13). Therefore, this study has a limitation that is if it's possible with the methods used in this study, heart rate may or may not recover in the same time frame of the experimental methods without applying any method at all.

This study has another limitation, which is that heart rate elevation could be due to factors other than drinking caffeine. Research subject did not perform any actions and or consume food before conducting the experiment, but still elevated heart rate may still have occurred due to other factors. To further test this hypothesis in the future, we could do same experiments but drinking decaffeinated coffee instead. If heart rate remains constant, that probably means that heart rate increases because of the effect of caffeine and not some other unknown variable.

When these experiments were preformed, we observed some unexpected results. Heart rate before drinking caffeine was consistently changing while measuring it, which made it harder to detect heart rate. This problem was prevented by decreasing activity and food intake before measuring heart rate. Thus, before heart rate was measured, no walking was done and no food was eaten because they affect accuracy of heart rate number. We took into account the p-value for each result (using GraphPad), and all *p-values* indicate that results were not confounded by extraneous factors. Additionally, all three methods were tested using, same device measured the heart rate for consistency between conditions.

This study had another limitation which was sample size for each method. If this study was repeated, we would recommend testing each method on different people to see how sex, weight, and other biological factors would affect heart rate. In addition to heart rate, blood pressure, respiration rate, and blood oxygen can be measured.

MATERIALS AND METHODS

In this research, same 14 year old girl was used in testing the three methods. Subject consumed two teaspoons of Nescafe gold coffee beans in 200ml of warm water before testing the three methods. Two teaspoons of coffee beans may contain between 50-90 mg of caffeine. Subject's heart rate was measured before drinking caffeine, after drinking caffeine, and after trying each method. Heart rate measurements before drinking caffeine were taken with no activity beforehand so the heart rate could be accurate, and heart rate measurements after drinking coffee were taken when heart rate stabilized which took approximately 3-5 minutes. For example, when heart rate was measured as 85 beats per minute (bpm), before 3-5 minutes of measuring it averaged between 75-90 bpm, but after 3-5 minutes the heart rate stabilized at 85 bpm. For first method, the subject walked indoors for 6:33 minutes indoors. For second method

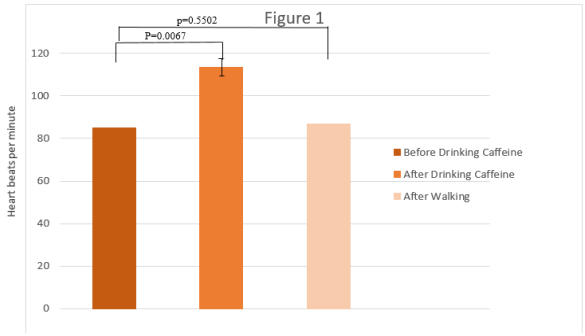

Figure 1: The average heart rate before drinking caffeine, after drinking caffeine, and after going for a walk (first method). The dark red bar represents heart rate before drinking caffeine; orange bar represents heart rate after drinking caffeine; light red bar represents heart rate after going for a walk (first method). First and second bar relationship is very statistically significant, and first and third bar relationship is significantly significant. Bars represent mean ± standard deviation.

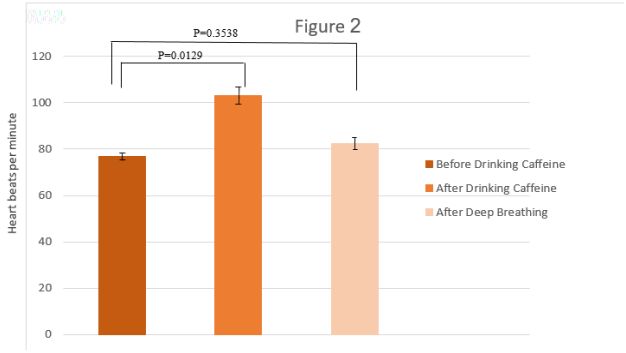

Figure 2: The average heart rate before drinking caffeine, after drinking caffeine, and after deep breathing (second method). The dark red bar represents heart rate before drinking caffeine; orange bar represents heart rate after drinking caffeine; light red bar represents heart rate after deep breathing (second method). First and second bar relationship is statistically significant; and first and third bar relationship is not statistically significant. Bars represent mean ± standard deviation.

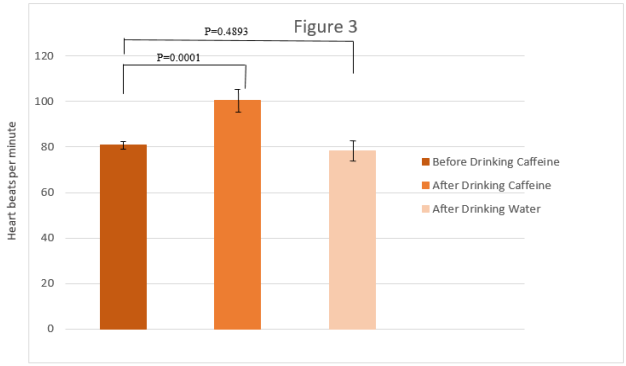

Figure 3: The average heart rate before drinking caffeine, after drinking caffeine, and after drinking water (third method). The dark red bar represents heart rate before drinking caffeine; orange bar represents heart rate after drinking caffeine; light red bar represents heart rate after drinking water (third method). First and second bar relationship is statistically significant; and first and third bar relationship is not statistically significant. Bars represent mean ± standard deviation.

5 minutes of deep breathing (exhale and inhale) was taken. For third method, subject drank 660 ml of water. Heart rate was measured using the Apple Watch Series 7 heart rate measuring app. Different results appeared depending on the different solutions being used as shown in **Figure 1**, **Figure 2**, and **Figure 3**. Additionally, heart rate was maintained after trying each the method. For accuracy, each method was tried a total of four times. Heart rate and methods were measured and applied in the same manner as the first trial with no differences. Figures were generated with Microsoft Excel and t-tests were performed with GraphPad t-test calculator (www.graphpad.com/quickcalcs/ttest1.cfm). To calculate the p-value, heart rate after drinking caffeine was subtracted from heart rate after trying each method to determine if the methods decreased the heart rate. After finding three differences of each repetition of the experiment, the z score was used ($z = (x-\mu)/\sigma$) and was added to the p-value formula, or probability value ($2 * \min\{Pr(S \leq x \mid H0), Pr(S \geq x \mid H0)\}$ to determine the p-value. Furthermore, to show the chance that the results could be random, the p-value was converted to a percentage.

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