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ORIGINAL ARTICLE

The Effect of Caffeine Consumed Before Competition on Heart Rate, Trigger Squeeze Time and Shooting Score in Air Pistol Athletes

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ABSTRACT

Background: Caffeine consumption may adversely affect the performance of athletes in some sports.
Aim: The aim of this study was to investigate the effects of caffeine drink consumed before competitions by air pistol athletes on their heart rate, trigger squeeze times and shooting scores.
Methods: : In the study, caffeinated and caffeine-free measurements were applied on the same athletes. Following the evaluation, a total of 20 elite athletes, including 10 women with a mean age of 23.6±4.7 and 10 men with a mean age of 25.9±4.8 who had at least 2 years sports history, participated voluntarily in the study. The study was planned as a single blind. All athletes shot 10 times before both measurements. By random method, the athletes consumed Coffee with 3mg/kg caffeine or decaf coffee before the measurement. After 1 week, the same athletes were given coffee which was not given in the previous measurement before the measurement. A total of 80 shots were fired at 15, 30 and 60 minutes after both measurements. Following the evaluation, heart rates, trigger squeeze times and shooting scores of the athletes were recorded. Wilcoxon test to compare the differences between the measurements at two different times on the same group and Mann-Whitney U test to examine the differences in independent groups were used.
Results: When the differences between the measurements of all male and female athletes were examined, it was found that there was an increase in their heart rate and trigger squeeze times 15, 30 and 60 minutes after caffeinated coffee consumption, and this difference was statistically significant ($p<0.05$). Besides there was a significant decrease in 15, 30 and 60 minute shooting scores of female athletes, and 15 and 30 minute shooting scores of male athletes ($p<0.05$).
Conclusion: As a result of the study, it was observed that the use of caffeine had a negative effect on the performance of air pistol athletes. Therefore, it can be said that people interested in air pistol discipline should not consume coffee or caffeine-containing beverages within 1-2 hours before the competition, if they consume, their heart rate will increase and their aiming during shooting will be more difficult and trigger-squeezing times will be extended.
Keywords: Air pistol, Caffeine, Heart rate, Shooting

INTRODUCTION

Air gun shooting competitions take place by shooting with air pistols or rifles at targets located at a distance of 10 m in a closed range. During shooting performance, technical knowledge is used in combination with mental focus. Physical strength and endurance are crucial to sustaining this process throughout the competition. Isometric status of muscles is one of the basic structures of shooting sport. Shooters have to control many extremities, joints and muscles from the feet to the wrist in order to keep the rifle and pistol in the desired position. In addition, all said components must be kept under control until the shot reaches the target.[1]

In a study investigating the effect of postural oscillation on shooting performance, it was emphasized that the body's oscillation exposed to gravity was less in elite shooters and that the less oscillation had a positive effect on shooting performance.[1]

In the discipline of air gun shooting, the movement of the air gun towards the target and the preparation required for shooting with the pistol in the correct position before the shooting is an important stage for the correct firing.[2] The shooter must be able to correctly align the front sight to achieve optimal firing success and to continue this process after creating the target sighting image.[2,3] According to empirical research, shooters should have the ability to control body oscillations for a stable and successful firing.[4,5,6]

Today, it is known that caffeine, which is an ingredient whose consumption increases day by day and whose usage areas increase, is consumed most in the form of coffee. A cup of coffee also contains approximately 100 mg of caffeine. Caffeine is consumed in many forms and produces various physiological effects in the human body. Its consumption is beneficial, but its long-term consumption is known to have some side effects on blood pressure in the body. Potential ergogenic effects of caffeine have been observed in many studies. These investigations have showed the beneficial in situations where loss of performance and fatigue increase in exercises requiring endurance below the maximal level.[7]

There are many reasons for caffeine consumption. The most well-known and widespread of these reasons are important factors such as staying fit, reducing physical stagnation due to the stimulant effect of caffeine and increasing attention and performance. Recent studies on caffeine have examined the effects of caffeine on the central nervous system, respiratory system, endocrine system, heart and circulatory system. It is known that especially caffeine has a stimulating effect on the nervous system and that athletes stay fit and awake, and their effects on the cardiovascular system increase heart rates and dilate blood vessels. For this reason, it is envisaged that the blood flow to the body cells will be faster and thus energy can be produced more rapidly. For this reason, caffeine was found by the WADA (World Doping Federation) for a period in the stimulants section of the prohibited substances list, but was not included in the doping list.[8]

To what extend and in which way the caffeine, which is known to have a positive effect on the performances of athletes in many sports branches due to its stimulating effect, may have the effect on the athletes' heart rhythms, the times when they concentrate for shooting, i.e. the trigger drop times and shot score performances in shooting sports requiring calmness, is a matter of interest in the shooting community in the shooting environment.

This study was planned to investigate the effect size of caffeine drink consumed by people interested in air gun sport before shooting competitions on heart rate, trigger drop times and firing scores. It is thought that the caffeine drink consumed may have a negative effect in this sport, since it is very important that heart rate is as slow as possible in order to have high concentration and avoid hand tremors. In the light of the data obtained, the study is expected to give information about the consumption of caffeine-containing beverages until a certain time before the competition or training to perform better in athletes and to be a guiding research. It is thought that the performance values of the athletes participating in this research will contribute to the development of sport in scientific sense.

MATERIAL AND METHODS

Research Group: A total of 20 athletes participated voluntarily in the research, 10 female athletes participating in both measurement programs, having at least 2 years of sports age and elite, with an average age of 23.6±4.7, and with a stature of 1.65±0.03 m and a body weight of 59.6±10.1 kg, and 10 male athletes with a mean age of 25.9±4.8, stature of 1.79±0.03 m and body weight of 82.7±11 kg. The dominant arms of all the athletes were right and they used their right arms when shooting. The measurements were carried out in 4-way shooting range of Gazi University, 10-way shooting range of 19 May and 4-way shooting range of Umitköy Dap. These 3 ranges have isolated properties for quality lighting, ventilation and sound insulation, preventing distortions of athletes' concentrates.

This study was started after the approval of the ethics committee of Ankara Yildirim Beyazit University Ethics Committee dated 21.11.2018 and numbered 19.

Data Collection: Stature - Body Weight - Body Mass Index Measurements: The statures of the participants were measured with a stadiometer measuring with an accuracy of ± 1mm. The athletes' body weights were measured with a scale measuring with an accuracy of ± 1 kg. Body mass index was calculated by the formula of BMI=Weight/Height x Height.[9]

Heart Rate Measurements (HRM): For all participating athletes, resting heart rate before caffeine consumption, and heart rate 15 minutes after, 30 minutes after and 60 minutes after caffeine consumption were measured using polar clock.

Trigger Squeeze Time Measurements (TST): In all of the 40 shots fired by all the athletes involved in the study, the timing of the trigger squeeze was measured by the same person with a stopwatch.

Score Measurements: Before all athletes' consumptions of caffeinated or decaffeinated coffee, 15 minutes, 30 minutes and 60 minutes after their coffee consumption, 10 shots were made and measurement results were taken.

Coffee Consumption Method: The athletes were told to stop physical activity 48 hours before the measurements and not to smoke, drink alcohol or caffeine. On the day of measurement, as in Share (2009) and Loo (2014) studies, all athletes participating in the study were provided to consume 3 mg/kg of caffeine-containing coffee.[10,11] In measurements, roasted, ground and 100% water soluble coffee beans of Standard Nescafe Gold branded caffeinated coffee and Nescafe branded decaffeinated coffee were used. Consumed coffees were prepared by mixing with 250 ml of warm water without adding sugar and milk powder.

Ratio and proportion calculation was made considering the athletes' body weights and the amount of coffee to be consumed was prepared with Sinbo SKS-4523 brand sensitive kitchen scale.

Measurement Protocol: The measurements were carried out in Gazi University, 19 Mayıs and Ümitköy Dap Shooting Ranges. Firstly, the anthropometric measurements of the athletes were taken and BMI values were determined.

In the study, caffeinated and caffeine-free measurements were applied on the same athletes. All athletes shot 10 times before both measurements. By random method, the athletes were allowed to consume Coffee with 3 mg / kg caffeine without adding milk or milk powder in 250 ml of warm water before the measurement and decaf coffee without adding milk or milk powder into 250ml warm water. After 1 week, the same athletes were given coffee which was not given in the previous measurement before the measurement. A total of 80 shots were fired at 15, 30 and 60 minutes after both measurements. Following the evaluation, heart rates, trigger squeeze times and shootinh scores of the athletes were recorded. There were no athletes who participated in the first and did not participate in the second measurement. Measurements are planned to coincide with the same day and hour at one week intervals.

Statistical Analysis: The data obtained were analyzed through Microsoft Excel 2007 and IBM SPSS Statistics 22.0 statistical program. Graphical approximations and normality tests (Kolmogorov-Smirnov - Shapiro-Wilk test) were used for the normal distribution of data. According to the results of the "Normality Test" in the measurements, it was observed that the normal distribution assumption was impaired in most of the measurements. For this reason, nonparametric Wilcoxon test to compare the differences between the measurements at two different times on the same group and Mann-Whitney U test to examine the differences in independent groups were used. Statistical significance level was accepted as $p<0.05$.

RESULTS

The mean body mass, stature and body mass index (BMI) of the participating athletes are given in Table 1.

Table 1: Anthropometric data of athletes.

Athletes (n=20)	Female (n=10)	Male (n=10)
Body Mass (kg)	59.6 ± 10.1	82.7 ± 11.0
Stature (m)	1.65 ± 0.03	1.79 ± 0.03
BMI (kg/m²)	21.83 ± 3,6	25.93 ± 3.2
Age (years)	23.6 ± 4.7	25.9 ± 4.8

The measurement results (Wilcoxon) determined after caffeine and decaffeinated coffee consumption of the female athletes participating in the study are given in Figure 1.

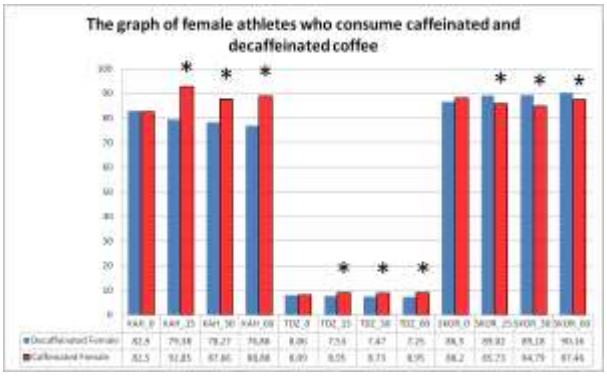

Figure 1: Statistical measurement graph of female athletes who consume decaffeinated and caffeinated coffee. *p<0.05

When the differences between the measurements of female athletes were examined, it was seen that there was a significant increase in heart rate and trigger squeeze times 15, 30 and 60 minutes after caffeine coffee consumption ($p < 0.05$). A significant decrease was revealed in the determined shooting scores after 15, 30 and 60 minutes of the measurement ($p<0.05$).

The measurement results (caffeine and decaffeinated coffee consumption) of the male athletes participating in the study (Wilcoxon) are given in Figure 2.

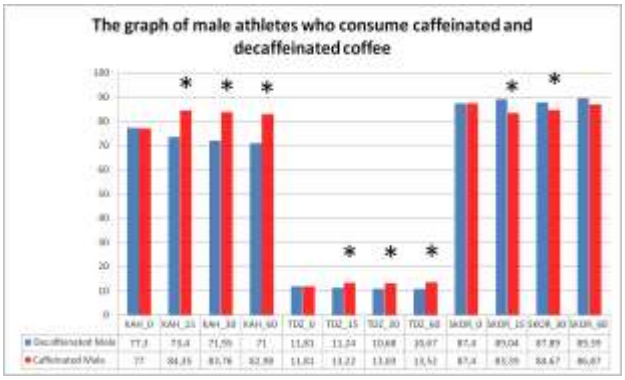

Figure 2: Statistical measurement graph of male athletes who consume decaffeinated and caffeinated coffee. *p<0.05

When the differences between the measurements of male athletes were examined, it was found that there was a significant increase in heart rate and trigger squeeze times 15, 30 and 60 minutes after caffeine coffee consumption ($p < 0.05$). A significant decrease was revealed in the determined shooting scores after 15 and 30 minutes ($p < 0.05$). It was found that there was a decrease in the mean shooting score of 60 minutes, but this decrease was not statistically significant ($p > 0.05$).

The results of the measurements determined after caffeine coffee consumption of male and female athletes participating in the study (Mann Whitney U) are given in Figure 3.

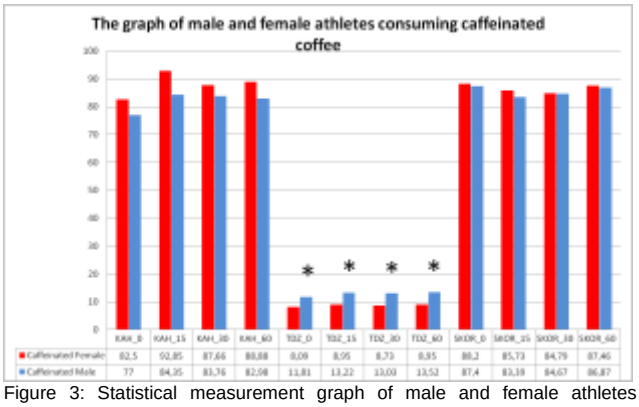

Figure 3: Statistical measurement graph of male and female athletes consuming caffeinated coffee. *p<0.05

Looking at the heart rate measurements of male and female athletes consuming caffeine coffee, no statistically significant difference was found in the athletes' heart rate and shooing scores ($p > 0.05$). At the time of trigger reduction, it is seen that the mean trigger squeeze of men at the start, and 15, 30 and 60 minutes later is higher and statistically significant compared to female ($p<0.05$).

The results of the measurement after decaffeinated coffee consumption of male and female athletes participating in the study (Mann Whitney U) are given in Figure 4.

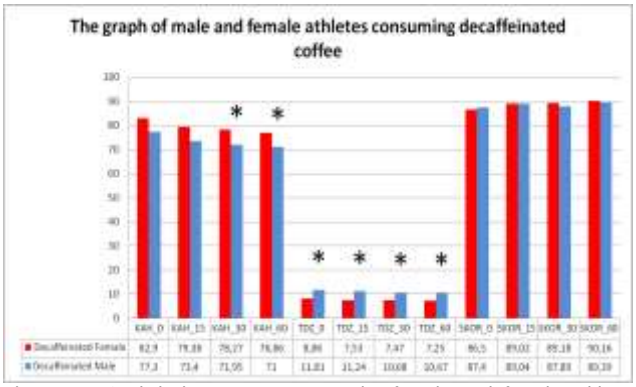

Figure 4: Statistical measurement graph of male and female athletes consuming decaffeinated coffee. *p<0.05

When we examined the heart rate of male and female athletes who consumed decaffeinated coffee, it was found that the male athletes' heart rates after 30 and 60 minutes were lower than that of female and this difference was statistically significant ($p < 0.05$). There was also a decrease in heart rate at start and after 15 minutes, but this decrease was not statistically significant ($p > 0.05$). It was found that the trigger squeeze times of female at start, and 15, 30 and 60 minutes later were lower than that of male and the difference was statistically significant ($p < 0.05$). No statistically significant difference was found in the shooting scores ($p>0.05$).

DISCUSSION

In this study, the effects of caffeinated and decaffeinated coffee consumption on heart rate, trigger squeeze time and shooting score in air gun athletes were discussed.

When the differences between the measurements of all athletes were examined, it was observed that there was a significant increase in heart rate 15, 30 and 60 minutes after caffeine coffee consumption ($p < 0.05$). This result is in parallel with the results obtained in other studies. In a study conducted by Sağlam and Genç, it was reported that substances such as caffeine and nicotine adversely affect blood circulation by increasing heart rates.[7] In a study conducted by Kaynar et al., It was stated that cardiac output, heart's work and oxygen consumption increased with caffeine consumption.[12] In another study, it was shown that theobromine, which is formed by the transformation of caffeine in the body, enlarges the vessels and increases heart rate and beats.[13] In a study investigating caffeine consumption, it was said that the amount of catecholamine secreted from the adrenal gland increases and the renin activity in plasma will increase with consumption.[14,15,16] In a study conducted by Brian et al., It was stated that after caffeine consumption, firstly blood pressure and pulse would increase and both would decrease to normal level after two hours.[8] In another study, it was stated that shooters should avoid excessive fatty foods, pastries, desserts, animal fats, drugs, stimulants, fries, artificial sugar, cigarettes, steeped tea, coffee, alcoholic and cola drinks, and that it is important to provide nutrition information to athletes as part of training. It is stated that a consumed coffee or a cigarette affects the nervous system all day and therefore it is very important to avoid such substances at the time of shooting.[7]

When the differences between the measurements of the male and female athletes in our study were examined, it was seen that there was a significant increase in trigger squeeze times after caffeine coffee consumption after 15, 30 and 60 minutes ($p < 0.05$). It was found that it is even more difficult for athletes to concentrate and aim at the target due to the oscillation and tremor in their hands with the effect of increasing heart rate. In the study of Sağlam and Genç, it was stated that athletes would begin to feel fatigue in a shorter period with decreased body resistance as a result of caffeine consumption. It was stated that fatigue occurs because caffeine negatively affects blood circulation by increasing heart beat and as a result of this, the oxygen required by the muscles cannot be met.[7] In a study investigating the effects of caffeine, heart palpitations, tremor and restlessness were reported in 13 of the subjects.[17]

A significant decrease was determined in shooting scores of female and male athletes after 15 and 30 minutes of the measurement ($p < 0.05$). It was found that there was a decrease in the mean shooting score of 60 minutes in male athletes, but this decrease was not statistically significant ($p > 0.05$). In the study of Sağlam and Genç, it was stated that caffeine consumption would increase the excitement that occurred at the time of the shot and would cause unintended shots.[7] Also in the study of Keles, it was stated that caffeine consumption increased pulse rate, caused tremors and oscillations and thus negatively affected the shooting performance.[18] In a study performed by Akça et al., It was stated that high doses of caffeine consumption may adversely affect the performances of the subjects with an increase in nausea, tremor and feeling of anxiety.[19,20,21]

Contrary to air gun discipline, it is thought that caffeine has a positive effect on performance due to its stimulant effect in many sports branches. In a study examining the effect of caffeine on physical performance, it was stated that the positive effect of caffeine supplementation in long-term aerobic activities is frequently shown in the literature.[19]

It is thought that due to the increase in heart rhythm in the target sports such as air gun and archery, shaking hands, oscillation and non-concentration in the position of taking aim result in a decrease in the performance of the shot score.

Caffeine, one of the most widely consumed foods and

supplements in the world, is mostly consumed in the form of coffee. Also, many foods, beverages and medicines contain caffeine. The active ingredient of energy drinks, whose consumption has increased recently, is also caffeine and is consumed as an ergogenic helper with its physiological effects in the body. Many studies have been conducted on the benefits and side effects of caffeine. For adults without any health problems, the amount of caffeine up to 400 mg per day (almost 5.5 mg/kg for a person weighing 75 kilograms) is reported to be safe and does not cause any health risks to the body. For ergogenic effects, it is very important that coaches and athletes provide information on the use of caffeine to support their performance.[19]

Practical implications: In our study, it was observed that when athletes consume decaffeinated coffee, the heart rate decreases, the trigger squeeze time decreases and the score performances increase in favor of shooting time. This shows that decaffeinated coffee has no effect. It is because the shooters continue to shoot under calmer, more stagnant conditions every second after the competition starts. Thus, their heart rate slows down gradually, they begin to concentrate better and the time of trigger squeeze is shortened. The effect of concentration and slowing of the pulse results in better shot scores.

In our study parallel with the results of the literature, it can be said that caffeine increases the heart rate and thus negatively affects trigger squeeze time, accurate shooting and shooting score.

CONLUSIONS

According to the results of our study, the heart rates of the athletes increase with the use of caffeine and accordingly, the athletes' concentration time during the shootings increases. It is also recommended that athletes do not consume beverages containing coffee or caffeine before the competition in order to have a negative impact on athlete's shooting scores, and if there are athletes who consume it, they should stop consuming such beverages at least 1-2 hours before the competition.

What does this article add?: Shooters are advised to explore other ways of improving physical performance, rather than considering caffeine as a supplement to improve their performance. In addition, if you intend to use caffeine during a competition or training, we recommend that you use it under medical supervision to ensure that consumption levels are safe and appropriate.

Limitations: If studies involving more athletes are made, the data to be obtained will have beneficial results for the shooting and scientific community.

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