



The Impact of Caffeine Content in Espresso on Cardiovascular Endurance

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ABSTRACT

This study aims to determine the impact of caffeine content ranging from 94-150 mg in espresso on the cardiovascular endurance of volleyball players. The research employed a quantitative approach, specifically a quasi-experimental method with a one-group pretest-posttest design. The population for this study comprised 14 members of the volleyball team in Dusun Kalangbangi Lor A. The sampling technique involved screening, and data analysis was conducted using the paired sample T-test, preceded by the Shapiro-Wilk test for normality and the test of homogeneity of variances for homogeneity testing. The research findings revealed that the calculated t-value (t-statistic) was greater than the critical t-value (t-table), specifically $5.612 > 2.365$, indicating the acceptance of the alternative hypothesis (H_a) and the rejection of the null hypothesis (H_0). Consequently, the conclusions drawn from the study are as follows: (1) There is an impact of caffeine when consumed in sufficient amounts. (2) Based on linear regression analysis, the R-Square value was found to be 0.891. This implies that the impact of consuming caffeine with a content of 94-150 mg in the short term on cardiovascular endurance is 89.1%, with the remaining 10.1% influenced by other factors. Therefore, consuming 94-150 mg of caffeine 30-60 minutes before undergoing a multistage fitness test can have a positive influence on cardiovascular endurance.

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INTRODUCTION

In general, sports are considered a fundamental need for all individuals in their lives, aiming to maintain and improve physical condition and health (Prasetyo, 2015). Sports involve a series of organized and planned physical activities with the goal of preserving and enhancing movement capabilities. Furthermore, sports aim to maintain and improve the quality of an individual's life, as mandated by the National Sports System Law Number 3 of 2005, defining sports as "systematic activities to encourage, develop, and nurture physical, spiritual, and social potential" (Giriwijoyo, 2013).

In the realm of sports, coffee has become increasingly consumed before exercise to enhance performance and prevent fatigue (Nandatama et al., 2017). Coffee is renowned for its main component, caffeine, an alkaloid xanthine crystal with a bitter taste. Caffeine acts as a mild diuretic and psychoactive stimulant (Fuentes, 2017). Caffeine is naturally present in food sources such as tea leaves, cocoa beans, and coffee beans (Yonata & Saragih, 2016). Processed products derived from these plants are commonly found in daily consumption, such as tea, chocolate, instant coffee, ground coffee, and carbonated beverages like Coca-Cola and Sprite, each containing varying percentages of caffeine.

Caffeine can enhance the absorption and release of calcium ions in muscle cells, thereby improving exercise performance in high-intensity, short-duration sports by increasing muscle strength and contraction efficiency. Additionally, caffeine stimulates the release of fatty acids from adipose tissue, enhancing endurance in prolonged sports activities. The utilization of fatty acids helps conserve muscle and liver glycogen at the initial stages of exercise, providing individuals with more energy reserves, ultimately contributing to better endurance and performance (SARI, 2018).

Endurance, or stamina, is a crucial physical indicator for both athletes and non-athletes. Individuals with good endurance can engage in various high-intensity activities and still have energy reserves for other tasks. Endurance can be categorized into muscle endurance and cardiovascular endurance. Muscle endurance refers to the ability of muscles to work continuously without feeling tired, while cardiovascular endurance is the effective and efficient use of the heart, lungs, and circulatory system for prolonged, high-intensity muscle contraction activities (Ningsi, 2019).

Nearly all sports disciplines demand good bodily endurance, and volleyball is no exception. Volleyball is a game played between two opposing teams, each consisting of 6 core members and several substitutes. It is a favorite sport in Indonesia, requiring various fundamental techniques such as overhand passing, underhand passing, serving, blocking, and smashing. Volleyball falls into the category of intermittent sports, meaning it involves several stages with low-intensity periods followed by short, high-intensity exercises (Zuqriva et al., 2022). For sports that demand high speed and intensity, the predominant energy system used is anaerobic. In contrast, for sports requiring endurance and prolonged activity (endurance), the main energy system is aerobic. Volleyball utilizes both aerobic and anaerobic systems, as both are essential for high intensity and cardiovascular endurance (Primasari & Widodo, 2021).

Considering the mechanism of caffeine, the concept of cardiovascular endurance, and the nature of volleyball as an intermittent sport, there is a connection between caffeine, cardiovascular endurance, and volleyball players. Volleyball is considered an intermittent sport, consisting of several stages with low intensity followed by short, high-intensity exercises. Based on field observations during training and matches,

coaches lack sufficient preparation for their teams, resulting in athletes struggling to maintain their performance, particularly concerning the rally point system. Coaches often provide only electrolyte drinks or mineral water without considering their content. Therefore, there is a need for updates on improving athlete performance rapidly using caffeine intake. The research question arises: Does caffeine intake have an impact on cardiovascular endurance? To answer this question, further investigation is required under the title "The Impact of Caffeine Content in Espresso on Cardiovascular Endurance."

RESEARCH METHOD

This research employs a quantitative approach using measurement tests. The research design used is a quasi-experimental design due to the difficulty in finding a control group for this study (Sugiono, 2015). Quantitative research is a scientific method that involves numerical or numeric calculations. It is considered a scientific method due to its rational, systematic, measurable, and objective nature (Mathar, 2013). Experimental research is a method designed to determine the effects of a specific behavior (Sugiono, 2015). The research design used in this study is the One Group Pretest-Posttest Design. This model includes a pretest (before treatment). Therefore, treatment outcomes can be determined more accurately by comparing them with the pre-treatment conditions (Sugiono, 2015). In this research, there is no control group, and subjects are not randomly selected.

The study will be conducted at the volleyball field of Dusun Kalangbangi Lor A, Semanu, Gunung Kidul, Yogyakarta. The research is scheduled to take place from January 14, 2024, to January 17, 2024. The initial phase of the research includes a pre-test scheduled for January 14, 2024, as agreed upon with the team. Subsequently, the second phase of the research will be conducted on January 17, 2024, as agreed upon with the team to perform the post-test.

The population in this study includes members of the Volleyball Team of Dusun Kalangbangi Lor A, consisting of 14 members. Purposive sampling is used for sample selection. According to Sugiyono, purposive sampling is a sample selection technique based on certain considerations (Muslimin, 2021). Sample determination is done using a questionnaire, resulting in a sample of 8 members from the Volleyball Team of Dusun Kalangbangi Lor A.

Data collection in this study involves screening or filtering the population to obtain samples, followed by tests and measurements on the screened samples. The test used in this research is the Multistage Fitness Test to measure cardiovascular endurance (Sepdanius et al., 2019).

Using SPSS version 25, the data analysis method includes descriptive analysis, data requirement tests, hypothesis tests, and linear regression analysis. Two measures

of central tendency are used to describe the data: mean and standard deviation. Inferential statistics include tests for normality, paired sample t-test, and linear regression analysis.

RESULTS AND DISCUSSION

This research was conducted at the volleyball court in Kalangbangi Lor A Hamlet, Semanu, Gunung Kidul, Special Region of Yogyakarta. The research was carried out from January 14 2024 to January 17 2024.

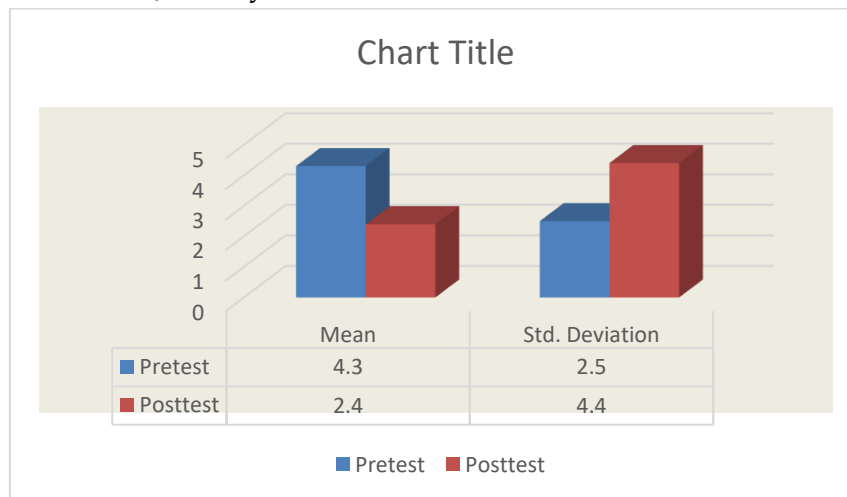


Figure 1.

Histogram of Pretest and Posttest Description Data

The total pretest score is determined from the description of the pretest and posttest data, with an average pretest score of 41.63 and a standard deviation of 3.543. Data processing for the pretest produced a final score of 333, while data processing for the posttest produced an average score of 44.63 and a standard deviation of 2.387. The total score after posttest data processing was 357. This shows that there is a difference in the increase in Vo²max results in the pretest and posttest.

Table 1.

Normality Test

		Tests of No Normality					
		Kolmogorov-Smirnova			Shapiro-Wilk		
	Kelompok	Statistic	Df	Sig.	Statistic	Df	Sig.
Nilai	Pretest	0,205	8	.200*	0,897	8	.273
	Posttest	0,239	8	.199	0,877	8	.175

Based on Table 1, the normality test through the SPSS output results shows the Sig value. (2-tailed) pretest was 0.273 > 0.05 and the Sig. (2-tailed) posttest was 0.175 > 0.05. Therefore, based on the determinants of the Shapiro-Wilk normality test, it can be

concluded that the data is normally distributed. This means that the normality requirements are met.

Table 2.
T-test results

		Paired Samples Test						
		Paired Differences						
		95% Confidence Interval of the Difference						
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	Sig. (2-tailed)
Pair 1	Pretest-Posttest	-3,000	1,512	0,535	-4,264	-1,736	-5,612	0,001

Based on table 4.5, the "Paired Samples Test" output shows the Sig value. (2-tailed) is $0.001 < 0.05$, then H_a is accepted and H_0 is rejected. So it can be concluded that there is a difference between the average pretest and posttest results of -3,000, meaning there is an impact on the Vo^2_{max} results that were not treated and the Vo^2_{max} results that were treated.

Based on the calculated t table, it is known that the variable t value is 5.612 and the t table is 2.365. Because the calculated t value $>$ t table = $5.612 > 2.365$, it can be concluded that H_a is accepted and H_0 is rejected. This means that there is an impact of caffeine if consumed in sufficient levels.

Table 3.
Linear Regression Test
Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.944 ^a	0,891	0,873	0,851

Based on the linear regression test table, the R Square value or coefficient of determination (KD) is obtained which shows how big the impact of consuming caffeine is on cardiovascular endurance. The KD value obtained was 89.1% which can be interpreted as having an impact on caffeine if consumed in sufficient levels and the other 10.1% is influenced by other factors.

Discussion

Cardiovascular endurance is one of the components of physical fitness that athletes need to possess. Cardiovascular endurance is essential for athletes to maintain

their performance in both training and competition. The Multistage Fitness Test is one way to assess the extent of cardiovascular endurance in athletes.

In this study, the researcher administered caffeine before conducting the Multistage Fitness Test. The research data, analyzed using the T-test at a significant level of 5%, revealed that the alternative hypothesis (H_a) is accepted, and the null hypothesis (H_o) is rejected. This indicates an impact on the Vo^2max results between the group that did not receive treatment and the group that received treatment. This is supported by the calculated t-value of $> t-table = 5.612 > 2.365$ or a p-value of $0.001 < 0.05$. The pretest and posttest data for the experimental group show a pretest total score with an average of 41.63 and a standard deviation of 3.543. The pretest data processing obtained a total score of 333, while the posttest data processing resulted in an average score of 44.63 and a standard deviation of 2.387. The posttest data processing obtained a total score of 357. This indicates an improvement in Vo^2max results with caffeine consumption.

The correlation coefficient (R) is represented in the table, and the correlation value is 0.944^a . The table also provides the R Square or coefficient of determination (KD), indicating the short-term impact of caffeine consumption. The obtained KD value is 89.1%, interpreted as 94-150 mg of caffeine has a short-term impact on cardiovascular endurance, and the remaining 10.1% is influenced by other factors. Consuming 94-150 mg of caffeine 30-60 minutes before the Multistage Fitness Test can positively influence cardiovascular endurance.

CONCLUSION

Based on the research results and discussion, it is known that the calculated t value $> t table = 5.612 > 2.365$ or p value $0.001 < 0.05$. Thus H_a is accepted and H_o is rejected. This means that there is an impact on the untreated Vo^2max results and the treated Vo^2max results.

The impact of consuming 94-150 mg of caffeine in the short term on cardiovascular disease is 89.1% and the other 10.1% is influenced by other factors. Consuming 94-150 mg of caffeine within 30-60 minutes before doing the Multistage Fitness Test can have a positive impact on cardiovascular endurance.

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