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by Hansi Effendi

Submission date: 22-Jul-2024 03:43PM (UTC+0700)
Submission ID: 2420670201
File name: article_satria.doc (432K)
Word count: 2919
Character count: 17109

HALAMAN OLAHRAGA NUSANTARA (HON)
Jurnal Ilmu Keolahragaan

Volume 7 No II
Tahun 2024

ISSN 2614-2775 (Print)
ISSN 2621-8143 (Online)

CAFFEINE DRINK AND ENERGY GEL INCREASE AEROBIC ENDURANCE

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Abstract
Human physical abilities are divided into anaerobic and aerobic abilities, where aerobic endurance (cardiovascular fitness) involves the process of oxygen uptake, transport and utilisation. Coffee consumption before exercise can improve performance and prevent fatigue, especially if caffeine is consumed one hour before exercise, which can improve running performance. The aim of this study was to examine the effectiveness of caffeinated drinks and energy gels before high-intensity exercise over a long period of time. This study used a pretest-posttest method with participants of 30 students from extracurricular futsal at MAN Lumajang, divided into two groups: E1 (caffeinated drink) and E2 (energy gel), 15 students each. Measurements used the Balke test and data were analysed using the Mann Whitney test in SPSS. The results of hypothesis analysis using the Mann-Whitney test showed a significant difference between variables E1 (caffeinated drink) and E2 (energy gel) with a significance value of p = 0.011, indicating a significant difference between the two groups. The conclusion of this study is that caffeinated drinks and energy gel provide different impacts in improving aerobic endurance performance.

Keywords: *Caffeinated beverages, energy gel, aerobic endurance*

Submitted : 25th of May 2024
Accepted : 20th of July 2024
Published : 22th of July 2024
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DOI http://dx.doi.org/10.31851/hon.v7i2.16053

INTRODUCTION

Human physical abilities, especially in the context of exercise and sport, are divided into two main categories: anaerobic and aerobic abilities. High anaerobic ability allows a person to perform simple to hard movements repeatedly, while aerobic ability delays the level of fatigue and helps overall recovery (Rohaya, 2018). In practice, physical exercise is an effort to increase a person's maximum capacity, including aerobic endurance which is related to the

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process of taking, transporting and using oxygen, and is also called cardiovascular fitness (Hardiansyah et al., 2020)

Several previous studies have highlighted the impact of aerobic and anaerobic physical activity on various aspects of health, including increasing the volume of leukosis without significant differences between the two (Harahap, 2017). Additionally, research by (Boullosa et al., 2020) shows that endurance running is an important biological trait linked to the survival of the human species, so millions of people participate in endurance running races every weekend around the world.

As recreational sports such as marathons and road races gain popularity, there is increasing interest in understanding the factors that can improve physical performance. One factor that is often studied is caffeine consumption. (Spriet, 2014) shows that consuming 150–200 mg of caffeine one hour before exercise can improve running performance. Caffeine has been shown to improve exercise performance in certain doses, although the effects can vary between individuals (Guest et al., 2021)

Apart from caffeine, there are energy drinks and other ergogenic ingredients that are also believed to improve physical performance. (Bäcker MH, 2023) found that energy drinks with 2 mg caffeine/kg could increase endurance without causing significant negative side effects. Other research by (Tritama, 2019) shows that robusta coffee is more effective in increasing VO2max than energy drinks in badminton athletes. Maulana (2023) found that plantains were more (Ahmad et al., 2023) effective than coffee with minimal caffeine in increasing the VO2max of soccer players.

The urgency of this research was driven by field observations at the 2022 national triathlon selection, where many athletes used caffeinated drinks and energy gels to improve aerobic performance. Therefore, this study aims to compare the effectiveness of caffeinated drinks and energy gels on aerobic

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endurance, in order to find out which one best supports athletes' aerobic performance.

It is hoped that this research can make a significant contribution in the field of sports, especially in terms of intake that can support athlete performance. Apart from that, this research also provides new insights for athletes, coaches and researchers regarding the use of caffeinated drinks and energy gels to increase aerobic endurance.

METHOD

This research uses an experimental design with a pretest and posttest design with a control group. In this study, two experimental groups were involved: experimental group I which was given caffeinated drinks and experimental group II which was given energy gel. The population in this study were extracurricular futsal players at MAN Lumajang, numbering around 20 players. Samples were taken by total sampling and then divided randomly into two groups, each consisting of 15 players.

Inclusion criteria include males aged 16-18 years, active futsal extracurricular students, not currently taking medication, no history of heart disease, not obese (normal BMI 19-26 kg), not active smokers, not professional athletes, and willing to be a research sample by signing informed consent. Exclusion criteria included not having congenital diseases, not being allergic to caffeine, and not experiencing pain

The research will be carried out in June 2024 and will be carried out at the MAN Lumajang yard. Research variables include caffeinated drinks with a dose of 150 ml, energy gel with a dose of 50 ml, and aerobic endurance. The caffeinated drink used is the KRB brand, while the energy gel used is the EJ brand. Aerobic endurance is defined as physical activity that can be carried out continuously and over a long period of time.

The research instrument includes implementation procedures, administering caffeinated drinks, administering energy gel, and carrying out the

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Balke test. At the first meeting, participants were only directed to carry out the Balke test without treatment. At the second meeting, the research sample was divided into two groups randomly: 15 people in treatment group I who were given caffeinated drinks and 15 people in treatment group II who were given energy gel. Caffeinated drinks and energy gels are given one hour before the Balke test.

The Balke test involves participants setting up at the starting line, running around a 400-meter course for 15 minutes without stopping or walking, and recording the distance covered. Participants are allowed to bring a smartwatch or use the Strava application.

Data were analyzed using the SPSS program to determine the differences between treatment group I and treatment group II. The normality test was carried out using the Shapiro-Wilk test because the sample size was less than 50. If the data was normally distributed, the One Way Anova test was used to see the differences between the two groups provided the data was normally distributed and homogeneous ($p > 0.05$).

If the data is normally distributed, Post-hoc analysis is carried out to see which groups have differences ($p < 0.05$). Data analysis includes descriptive analysis to get a general overview of the main data and supporting data with mean values, maximum values and minimum values presented in tabular form, normality analysis to determine whether the data is normally distributed or not, and hypothesis analysis using the independent sample test if data is normally distributed or Mann-Whitney test if the data is not normal.

RESULT AND DISCUSSION

This study compared the effects of giving caffeinated drinks and energy gels on aerobic endurance in 30 students who were members of the futsal extracurricular at MAN Lumajang. The research used a pretest and posttest method which was carried out over two meetings with a gap of four days for recovery. At the first meeting, respondents did a pretest without treatment. At the second meeting, respondents were divided into two groups: the caffeinated drink

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group (E1) and the energy gel group (E2), each consisting of 15 people. One hour before the test, both groups were given caffeinated drinks and energy gel according to their group.

Table 1. Sample Characteristics

Variable	Group	N	Mean	Std deviation	p-homogeneity	p-sig
Height	E1	15	167,60	4,896	0.329	0,933
	E2	15	167,80	7,646		
Weight	E1	15	67,33	13,626	0.101	0,087
	E2	15	59,93	8,689		
Pulse before running	E1	15	67,33	13,626	0.393	0,001
	E2	15	90,53	10,875		
Pulse after running	E1	15	167,60	4,896	0.001	0,003
	E2	15	140,67	31,384		
Pace Variable	E1	15	6,2827	1.09271	0.43	0,156
	E2	15	6,9560	1.41384		

From Table 1, it is found that the sample characteristics for each variable are almost similar. There are variations in characteristics that indicate homogeneity and inhomogeneity. The following is an explanation of the data analysis:

1. After analyzing the data, significant differences in height and weight were seen between the sample groups. This difference could occur due to random sample selection, which causes variations in height and weight among the sample groups used.
2. To determine the homogeneity of the population, researchers use the p-homogeneity value (>0.05) to indicate homogeneity and the p-homogeneity value (<0.05) to indicate inhomogeneity. Table 4.1 shows that sample characteristics such as height, weight, and pulse rate before running show p-homogeneity >0.05, which indicates the homogeneity of the sample population. However, the pulse rate after running showed p-homogeneity <0.05, indicating inhomogeneity.

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3. Analysis of Table 1 shows that there are no significant differences in height, weight, and pace (p-Sig > 0.05). However, there was a significant difference in heart rate before and after running (p-Sig <0.05).

Table 2. Normality and Homogeneity Test

Variable	Group	N	p-normality	p-homogeneity	Information
Pretest	E1	15	0.279	0.425	Normal and homogeneous (with notes
	E2	15	0.001		
Posttest	E1	15	0.532	0.537	Normal and homogeneous
	E2	15			

Based on the results of the data normality test, it was found that:

All groups showed a normal and homogeneous distribution, so hypothesis testing was carried out using parametric statistical tests. In the pretest, group E1 showed a normal and homogeneous distribution, while in the pretest, group E2 (energy gel) showed a distribution that was not normal but homogeneous, so the Wilcoxon non-parametric statistical test was used. In the posttest, both groups E1 and E2 showed a normal and homogeneous distribution, so that parametric statistical tests using the independent sample test could be carried out.

Table 3. Test the Difference Hypothesis

Group	*Mean* ± SD		p-Sig
	Pretest (M)	*Posttest* (M)	
E1	2031,33 ±321,133	2348,00±306,529	0,011
E2	1891,33±375,934	2100,67 ± 447,045	

Table 4.3 shows the results of the hypothesis test of the difference in distance traveled during the Balke test between groups E1 (caffeinated drinks) and E2 (energy gel). The results of the analysis showed that there was a significant difference between the two groups (p < 0.05), indicating that the effects of caffeinated drinks and energy gels were significantly different in influencing the distance traveled in the test.

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Discussion

After analyzing the data from this research, it was found that the non-parametric statistical test using the Mann-Whitney test on the variables caffeinated drinks and energy gels showed that there was a significant difference in aerobic endurance between E1 (caffeinated drinks) and E2 (energy gels), as seen from the p-Sig value in Table 4.3 ($p < 0.05$).

Energy sources obtained from carbohydrates, fats and proteins can come from vegetable or animal sources. The energy metabolism process involves enzymes as catalysts to convert this energy source into ATP (adenosine triphosphate), which is essential for muscle contraction and cellular function (Rismayanthi, 2019).

Nutrient needs such as carbohydrates, protein, fat, fiber, fluids and micronutrients are very important to maintain health, support training adaptations and increase stamina both during training sessions and competitions. Carbohydrates have a major role as a source of energy for athletes during exercise. For example, soccer athletes benefit significantly from complex carbohydrates to maintain adequate muscle glycogen stores, which can be found in whole grains (Desiplia et al., 2018).

The differences in ingredient composition and dosage between the two variables used in this study influence their effectiveness in increasing aerobic endurance. Nevertheless, they have some similarities, such as the B group of vitamins and sugars, which contribute to improved athletic performance. Caffeine, for example, not only provides direct benefits to the nervous system affecting skeletal muscle function, but also improves athletic performance by improving aerobic endurance and muscle exercise repetition capacity (Hussain, 2022).

It is generally accepted that consuming moderate to high doses of caffeine (5-9 mg/kg body mass) before and during exercise can increase endurance. Caffeine has also been shown to be beneficial in high-intensity training and in

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team sports requiring stop-and-go movement patterns, where anaerobic energy production has a significant impact on performance (Spriet, 2014).

Both types of drinks contain sugar which acts as an energy source to prevent muscle fatigue during aerobic activity. Sugar is a simple carbohydrate consisting of one or two sugar molecules, providing fast energy for the body. Increased physical and mental fatigue is mainly caused by energy-draining activities; without an adequate energy supply, fatigue will set in. When exercising, muscle contractions produce substances such as lactic acid, CO2, and phosphoric acid, which can affect the strength and ability of muscle contractions (Abdurahman et al., 2018)

L-carnitine plays an important role in the world of sport and among athletes, with a number of studies highlighting its effects especially in endurance-focused athletes. This supplement is often used to increase fat oxidation during exercise and maintain muscle glycogen levels. As a performance enhancer, L-carnitine is also known for its ability to increase red blood cell production, which provides additional benefits especially in stressful physical conditions (Grivas & Grivas, 2018)

Maltodextrin and dextrose are carbohydrate polymers commonly used as food sources in sports. The ergogenic benefits of both are significant, including increased strength, faster recovery, and more efficient gastric emptying compared with glucose solutions. This feature helps prevent sudden drops in blood glucose levels and reduces the risk of hypoglycemia caused by hyperinsulinemia during physical activity (Hartley et al., 2022).

Aerobic energy metabolism is essential to support muscle contraction, which is the basis of human physical movement characterized by interactions between actin and myosin. Adenosine triphosphate (ATP) acts as the main component that triggers this activity. In endurance sports such as football, ATP plays a crucial role as the main energy source (Sandi, 2019).

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ATP supply becomes very important for soccer athletes during training and competition, especially through aerobic metabolism. Although both carbohydrates and fat function as sources of nutrition for aerobic metabolism, carbohydrates are preferred because of their efficiency as the main energy source (Lisnawati et al., 2023). Based on the composition of these two variables that support performance in endurance training, this research indicates that there are significant differences.

CONCLUSION

Based on the research findings, it can be concluded that there is a significant difference in the effect of caffeinated drinks and energy gels on aerobic endurance. Both caffeinated drinks and energy gels can be effectively used to improve performance when doing aerobic activities.

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