Sportis
Revista Técnico-Científica del Deporte Escolar, Educación Física y Psicomotricidad
Scientific Technical Journal of School Sport, Physical Education and Psychomotricity

Editor: University of A Coruña. A Coruña. Spain
ISSN-e 2386-8333
E-mail: sportis.journal@udc.es **Web**: https://revistas.udc.es

Original article. Comparative analysis of three energy drink consumption timings on front crawl performance of collegiate swimmers. Vol. 11, n.º 1; p. 1-26, January 2025. https://doi.org/10.17979/sportis.2025.11.1.11220

Comparative analysis of three energy drink consumption timings on front crawl performance of collegiate swimmers

Análisis comparativo de tres momentos de consumo de bebidas energéticas en el rendimiento del estilo libre en nadadores universitarios

Rafael T. Celso

College of Sports, Exercise and Recreation, Bulacan State University, Malolos, Philippines https://orcid.org/0009-0003-9060-2637

*Correspondencia: Rafael T. Celso, rafael.celso@bulsu.edu.ph

Editorial schedule: *Article received 09/14/2024 Accepted: 10/22/2024 Published: 01/01/2025*
https://doi.org/10.17979/sportis.2025.11.1.11220

To cite this article use the following reference:
Celso, R.T. (2025). Comparative Analysis of Three Energy Drink Consumption Timings on Front Crawl Performance of Collegiate Swimmers. Sportis Sci J, 11 (1), 1-23 https://doi.org/10.17979/sportis.2025.11.1.11220

Author contribution: All authors contributed equally to the work.

Funding: The study did not obtain funding.

Conflict of interest: The authors declare that they have no conflict of any kind

Ethical aspects: The study declares the ethical aspects.

Sportis. Revista Técnico-Científica del Deporte Escolar, Educación Física y Psicomotricidad
Scientific Technical Journal of School Sport, Physical Education and Psychomotricity

Editor: University of A Coruña. A Coruña. Spain
ISSN-e 2386-8333
E-mail: sportis.journal@udc.es Web: https://revistas.udc.es

Original article. Comparative analysis of three energy drink consumption timings on front crawl performance of collegiate swimmers. Vol. 11, n.º 1; p. 1-26, January 2025. https://doi.org/10.17979/sportis.2025.11.1.11220

Abstract

The study aimed to compare three energy drink timings on the front crawl performance of 60 collegiate swimmers selected through purposive sampling. Specifically, participants consist of 30 females (50%) and 30 males (50%) equally distributed across three groups—Group 30, Group 40, and Group 1h—each containing ten females (16.67%) and ten males (16.67%), making up 33.33% of the total participants per group. Group 30 includes the participants who have 30 minutes of energy drink consumption timing prior to the testing. Group 40 has 40 minutes of energy drink consumption timing. Lastly, Group 1h includes the participants with an hour as their consumption timing. The study's instrument consists of a time trial of 50m, 800m, and 1500m front crawl performance recorded using a handheld stopwatch. The data gathering commenced after 30 hours of caffeine cessation for the participants. After this, each participant consumed a commercially available energy drink. The different energy drink consumption timings were implemented before administering the front crawl performances. Another 30 hours were observed to wash out the effects of the prior testing. The second testing commenced with the same protocol until the three front crawl performances were done. The data from the time trials were analyzed for differences through the Kruskal-Wallis H test. The between-group comparison of all participants for front crawl performance showed no significant differences in 50m, 800m, or 1500m events ($P > .05$). Similarly, male participants exhibited no significant differences across groups in all events, with P values for 50m, 800m, and 1500m events being (.90), (.17), and (.35), respectively. Female participants also showed no significant differences between groups, with P values of (.69), (.65), and (.31) for the 50m, 800m, and 1500m events, respectively. The study found no significant difference in the effects of consuming energy drinks at 30 minutes, 40 minutes, and 1 hour on 50m, 800m, and 1500m front crawl swimming performance, regardless of the swimmers' sex. Future studies were suggested to replicate the study for validation.

Keywords: swimming, energy drink, front crawl, athletic performance

Resumen

El estudio tuvo como objetivo comparar tres momentos de consumo de bebidas energéticas en el rendimiento del estilo libre (front crawl) de 60 nadadores universitarios seleccionados mediante muestreo intencionado. Específicamente, los participantes consistieron en 30 mujeres (50%) y 30 hombres (50%), distribuidos equitativamente en tres grupos: Grupo 30, Grupo 40 y Grupo 1h, cada uno con diez mujeres (16.67%) y diez hombres (16.67%), representando el 33.33% del total de participantes por grupo. El Grupo 30 incluyó a los participantes que consumieron la bebida energética 30 minutos antes de la prueba. El Grupo 40 consumió la bebida energética 40 minutos antes, y el Grupo 1h consumió la bebida una hora antes. El instrumento del estudio consistió en una prueba cronometrada de rendimiento en estilo libre de 50m, 800m y 1500m, registrado con un cronómetro manual. La recolección de datos comenzó después de 30 horas de cese de cafeína para los participantes. Después de esto, cada participante consumió una bebida energética disponible comercialmente.

Sportis
Revista Técnico-Científica del Deporte Escolar, Educación Física y Psicomotricidad
Scientific Technical Journal of School Sport, Physical Education and Psychomotricity
Editor: University of A Coruña. A Coruña. Spain
ISSN-e 2386-8333
E-mail: sportis.journal@udc.es Web: https://revistas.udc.es

Los diferentes momentos de consumo se implementaron antes de realizar las pruebas de estilo libre. Se observó un período de 30 horas para eliminar los efectos de la prueba anterior. Se inició la segunda prueba con el mismo protocolo hasta que se completaron las tres pruebas de estilo libre. Los datos de las pruebas cronometradas se analizaron para buscar diferencias a través de la prueba de Kruskal-Wallis H. La comparación entre grupos de todos los participantes no mostró diferencias significativas en el rendimiento en las pruebas de 50m, 800m y 1500m (P > .05). De manera similar, los participantes masculinos no exhibieron diferencias significativas entre grupos en todas las pruebas, con valores P de (.90), (.17) y (.35) para las pruebas de 50m, 800m y 1500m, respectivamente. Las participantes femeninas tampoco mostraron diferencias significativas entre grupos, con valores P de (.69), (.65) y (.31) para las pruebas de 50m, 800m y 1500m, respectivamente. El estudio no encontró diferencias significativas en los efectos del consumo de bebidas energéticas a los 30 minutos, 40 minutos y 1 hora sobre el rendimiento en natación estilo libre en 50m, 800m y 1500m, independientemente del sexo de los nadadores. Se sugirió que futuros estudios repliquen el estudio para su validación.

Palabras clave: natación, bebida energética, estilo libre, rendimiento atlético

Introduction

Energy drinks are common among athletes whose components consist of high levels of caffeine combined with substances such as taurine, guarana, ginseng, and B-vitamins (McLellan and Lieberman, 2012). It was claimed and marketed to enhance mental and physical prowess (El-Sabban, 2016). This has led to a high prevalence of its consumption among various populations. It was reported that at universities in Ghana, 62.2% of student-athletes consumed at least a can of energy drink per week (Buxton and Hagan, 2012). Similarly, among adolescents and athletes, there were 69% who consumed energy drinks, with 17% consumption per day (Nowak and Jasionowski, 2016). These patterns can be linked to several motivations behind energy drink consumption. Among college students, the need to study, to stay awake, and for social experiences are motivations for energy drink consumption (Oglesby et al., 2018; Droste et al., 2014). On the other hand, improvements in physical performance (Gutiérrez-Helln and Varillas-Delgado, 2021), endurance (Ivy et al., 2009), energy levels (Simulescu et al., 2019), and cognitive benefits (Tambalis et al., 2022) were some of the motivations of student athletes for the consumption of the beverage. Previous studies investigated that energy drink pre-workout consumption is an effective way to improve athletic performance in various sports events (Gutiérrez-Hellín & Varillas-Delgado,

Sportis
Revista Técnico-Científica del Deporte Escolar, Educación Física y Psicomotricidad
Scientific Technical Journal of School Sport, Physical Education and Psychomotricity
Editor: University of A Coruña. A Coruña. Spain
ISSN-e 2386-8333
E-mail: sportis.journal@udc.es Web: https://revistas.udc.es

2021; Pereira et al., 2022; Simulescu et al., 2019; Ivy et al., 2009). Energy drinks are a famous beverage among student-athletes used to improve physical performance.

Swimming involves a dynamic movement where the body uses both the lower and upper limbs to navigate through, on, and beneath the water (Viana et al., 2019). The repetitive nature of the sport (McKenzie et al., 2022) leads to various physical and physiological demands that enhance the endurance of both the cardiovascular and muscular systems (George and Westneat, 2019). It can be considered as low-intensity steady state activity (Masagca, 2024c) to high-intensity physical activity which utilizes body weight like calisthenics (Masagca, 2024a). The various strokes in swimming involve the coordinated movement of both the upper and lower limbs as the body moves through the water. With this, muscular endurance is a physical component that can be improved through this activity (Masagca, 2024b). These include freestyle, backstroke, butterfly, and breaststroke (Cohen et al., 2014; Bixler et al., 2014). The stroke is executed through a combination of alternating arm movements and a flutter kick, with the face kept submerged in the water while ensuring consistent breathing to the side (Cohen et al., 2014). This stroke is the quickest of all swimming techniques (Kjendlie et al., 2018; Barbosa et al., 2017; Morais et al., 2023). This is the same reason that clarifies why the freestyle stroke is technically referred to as front crawl (Hutchison, 2022; Sanders et al., 2023). Swimming involves dynamic, coordinated movements of the upper and lower limbs across various strokes, with the front crawl (freestyle) being the fastest and most efficient technique, enhancing cardiovascular and muscular endurance.

Depending on the specific chemicals and amounts used, energy drinks can affect swimmers' performance. Studies have demonstrated that the consumption of energy drinks containing caffeine can enhance performance in activities that require short bursts of effort, such as increasing jump height, handgrip strength, and swimming speed. Additionally, studies have found them to elevate blood lactate concentrations (Lara et al., 2015). However, studies on high-performing teenage female swimmers showed no significant impact on muscle strength, endurance, or blood lactate levels. However, there was a modest improvement in 100-meter crawl times (Arazi et al., 2016). According to Seifert and McKenzie (2007), energy gels that have a carbohydrate/protein ratio of 4:1 can improve performance during high-intensity training. Swimmers must carefully plan their nutrition due to the substantial energy deficits that occur during intense training. It is crucial for them to maintain a balanced energy intake in order to sustain performance and promote recovery. The prevalence of energy drink consumption can jeopardize heart muscle (Munteanu et al., 2018), and energy drinks with a mixture of alcohol create increased health risks (Marczinski & Fillmore, 2014). The said beverage can deliver immediate benefits, but its effectiveness varies depending on individuality, and probable long-term health risks should be taken into consideration.

Nutrient timing is defined as the manipulation of food intake at various times during exercise episodes to improve performance, recovery, and adaptation (Arent et al., 2020). Crbohydrate ingestion prior to exercise was seen to improve athletic performance (McConell et al., 1996). Additionally, when supplemented with a high-carbohydrate meal taken four hours before the exercise episode, it was investigated to increase performance through maintaining blood glucose levels. (Neufer et al., 1987). Specifically, 30 minutes before exercise, carbohydrate feeding improves exercise capacity (Galloway et al., 2014). As for the protein, consumption timing is also a very important aspect. Numerous studies have established that protein is one of the most robust predictors of muscle growth and strength (Schoenfeld, Aragon, & Krieger, 2013). As a macronutrient associated with muscle growth, it was suggested to be effective if consumed immediately after exercise (Hoffman, 2007). Specifically, an intake of 31 g/kg of high protein post-exercise is effective for muscle protein synthesis in young adults (Moore, 2019). As for the fat, several studies have explained its importance to exercise in endurance-based sports (Cornis et al., 2016). Fat intake before and during exercise was found to be beneficial for improving body composition in endurance sports (Helge et al., 2001). It also influences the hormonal response to exercise by regulating insulin and leptin, which are important for metabolism (Matsuo and Suzuki, 1999). As for the post-exercise intake, fat was observed in intramyocellular lipids, which is related to muscle recovery and adaptation in endurance-training athletes (Décombaz et al.,

Sportis. Revista Técnico-Científica del Deporte Escolar, Educación Física y Psicomotricidad
Scientific Technical Journal of School Sport, Physical Education and Psychomotricity
Editor: University of A Coruña. A Coruña. Spain
ISSN-e 2386-8333
E-mail: sportis.journal@udc.es Web: https://revistas.udc.es

2001). The timing of nutrition during exercise is very important in order to maximize its effect, which eventually benefits health and athletic performance.

Several studies utilized different consumption timings of energy drinks as pre-workout beverages to boost athletic parameters among various populations. In certain studies, participants induced physical activity 40 minutes after consuming energy drinks. A study applied the aforementioned timing of energy drink consumption to parkour performance, concluding that there was no significant improvement (Madureira et al., 2016). As for the endurance runners with the same energy drink consumption timing, improvement on the 5 km run was observed (Prins, 2015). Another study on energy drink-induced cycling performance also used the same timing (Periera et al., 2022). The study suggested that the combination of energy drinks and carbohydrates was superior to energy drinks in boosting performance. Researchers studied the impact of a locally available energy drink on cognitive function, mood, and cardiovascular parameters among gamers (Schwager et al., 2024). Several studies investigating power and energy drinks used 30 minutes of consumption time prior to physical or athletic activity. Consuming an energy drink 30 minutes prior to testing improved the upper body (Jacobson et al., 2018). However, the results differed from those obtained from counter-movement vertical jumps. For sprint triathlon athletes, the timing of energy drink consumption improves performance and reduces oxidative stress (Wang et al., 2022). Lastly, lower-extremity power-natured sports such as volleyball found the energy drink consumption timing of 30 minutes to be ineffective in improving physical performance related to the sports (Fernández-Campos et al., 2015). Several studies have recently used the longest energy drink consumption time of one hour to examine the impact of energy drinks on various physical performance parameters. Recreational runners found that consuming an energy drink an hour before testing did not improve performance and only increased systolic blood pressure (Peveler et al., 2017). Despite their fitness level, amateur runners experienced insignificant changes in physical tests (Rica et al., 2019). Lastly, the results of the previous studies were the same for the footballers in terms of their aerobic and anaerobic performance (Zileli et al., 2019). However, for physical fitness components that involved immediate maximal performance and reaction time, energy drink consumption timing was found to be

Sportis. Revista Técnico-Científica del Deporte Escolar, Educación Física y Psicomotricidad
Scientific Technical Journal of School Sport, Physical Education and Psychomotricity
Editor: University of A Coruña. A Coruña. Spain
ISSN-e 2386-8333
E-mail: sportis.journal@udc.es Web: https://revistas.udc.es

effective (Chtourou et al., 2019). Overall, the impact of when energy drinks are consumed on athletic performance differs greatly depending on the type of physical activity and the people involved. This suggests that the best timing for consuming energy drinks may depend on the specific requirements of the sport and individual differences.

The existing literature thoroughly focuses on the probable causal relationship between energy drinks and athletic performance in various populations. However, the comparison of the time of ingestion of energy drinks prior to physical activity or physical testing has not yet been investigated. The aim of the study is to compare the three different energy drink consumption times used by various studies about energy drinks and athletic performance. Additionally, the study aims to pinpoint the optimal timing for consuming the beverage to enhance front crawl swimming performance. Upon reviewing the literatrue review related to the study, the researcher came up with a hypothesis.

H1 There is no significant difference between 30 minutes, 40 minutes, and 1 hour as consumption timing on front crawl performance

Methodology

Research Design

This study employs a quantitative, comparative research design to examine the effects of three energy drink consumption timings (30 minutes, 40 minutes, and one hour before exercise) on front crawl performance in collegiate swimmers. Performance will be measured across three different distances: 50 meters, 800 meters, and 1500 meters

Sampling and Participants

Purposive sampling led to the selection of 60 participants for the study which was equally divided into three groups through random sampling. The participants were from state universities and collges around Bulacan province. The said sampling method was specifically used as the study was a basis for the development of a diet plan for collegiate swimmer athletes. Inclusion criteria were set when choosing the participants.

Sportis. Revista Técnico-Científica del Deporte Escolar, Educación Física y Psicomotricidad
Scientific Technical Journal of School Sport, Physical Education and Psychomotricity
Editor: University of A Coruña. A Coruña. Spain
ISSN-e 2386-8333
E-mail: sportis.journal@udc.es Web: https://revistas.udc.es

The following requirements were satisfied by the participants: (1) 18 years of age and older; (2) free from any medical problems that can be triggered by consumption of energy drinks and/or physical activity; and (3) engaged in formal swimming training for more than 4 years. Table 1 shows the distribution of participants' sex. Group 30 was assigned 30 minutes to wait for the energy drink to be fully absorbed by the body before the front crawl swimming performance. The group consists of 20 (33.33%) participants, with an equal number of female (16.67%) and male (16.67%) participants, which constitute 33.33% of the sample. As for 40, which had 40 minutes as the absorption of energy drinks for the testing, there were 20 participants, representing 33.33% of the total. Among these participants, there is an equal number of females (16.67%) and males (16.67%), making up 33.33% of the entire sample. Lastly, Group 1h had an hour as their consumption timing, representing 33.33%. The number of female participants was 16.67%, and the number of male participants was also 16.67%, making up 33.33% of the sample. This group was assigned to wait for 40 minutes for the energy drink to absorb before administering the front crawl swimming time trial.

Table 1. Sex distribution of the participants

	Female	Male	All
Group 30	10(16.67%)	10(16.67%)	20(33.33%)
Group 40	10(16.67%)	10(16.67%)	20(33.33%)
Group 1h	10(16.67%)	10(16.67%)	20(33.33%)
Total	30(50.00%)	30(50.00%)	60(100.00%)

Table 2 shows the demographic profiles of the participants in the study. Group 30 had a mean height of 170.23 ± 5.36 and a mean weight of 60.07 ± 10.45. As a result, the mean body mass index was 19.52 ± 3.12. The average fat mass was 10.2 ± 5.12, while the average lean body mass was 49.8 ± 5.47. As for Group 40, the mean height was 167.78 ± 4.78, and the mean weight was 65.89 ± 7.44. As a result, the mean body mass index was 22.4 ± 4.78. The average fat mass was 11.4 ± 8.12, while the average lean body mass was 53.6 ± 2.75. Lastly, for Group 1h, the mean height and weight were 168.11 ± 7.23 and 66.14 ± 6.47, respectively. As for the mean body mass index, it was 23.79 ± 3.56. The body composition was calculated to have a fat mass of 11.5 ± 3.21 and a mean lean body mass of 54.20 ± 4.65.

Editor: University of A Coruña. A Coruña. Spain
ISSN-e 2386-8333
E-mail: sportis.journal@udc.es Web: https://revistas.udc.es

Table 2. Demographic profile of the participants

	Group 30	Group 40	Group 1h
Height	170.23±5.36	167.78±4.78	168.11±7.23
Weight	60.07±10.45	65.89±7.44	66.14±6.47
Body Mass Index	19.52±3.12	22.4±4.78	23.79±3.56
Fat mass	10.2±5.12	11.4±8.12	11.5±3.21
Lean body mass	49.8±5.47	53.6±2.75	54.2±4.65

Instruments

The front crawl performance of the participants was quantified through the use of time trials for each event. Specifically, the performance was recorded through a handheld stopwatch (HS-3V-1R). This was utilized as this measurement signifies a high level of specificity in relation to the actual swimming event. In the absence of a swimming timing console, Hetzler et al. (2008) used handheld stopwatches as an instrument for measuring time. The study found that the said instrument did not significantly differ from electronic timing or another handheld stopwatch ($p > 0.99$), and the calculated intraclass correlation values among 200-meter running time data were high (0.988).

Data gathering

Limiting carry-over effect

Before the pretest began, the participants received guidelines to prepare for the testing. Specifically, they were advised to cease consuming caffeinated drinks 30 hours before the testing. Addicott and Laurienti (2009) suggested that individuals who were habitually consuming caffeine were found to have increased reaction time after 30 hours of caffeine intake cessation. This was implemented in order to clear up the possible carry-over effect of habitual caffeine intake through the ingestion of energy drinks, coffee, and other caffeinated foods.

Energy drink

Table 3 shows the nutritional facts of the energy drink which was consumed by the participants of the study. The energy contains carbonated water, sugar, acidity regulators (citric acid and sodium citrate), taurine, and caffeine (131 mg). It includes both natural and artificial flavors, sweeteners (sucralose and acesulfame potassium), and sodium benzoate as a preservative. The drink is colored artificially, including the use of

Editor: University of A Coruña. A Coruña. Spain
ISSN-e 2386-8333
E-mail: sportis.journal@udc.es Web: https://revistas.udc.es

tartrazine, and contains inositol and ginseng powder. Additionally, it is enriched with vitamins and minerals such as Vitamin B3 (niacinamide) at 8.0 mg, zinc sulfate providing 5.4 mg of zinc, Vitamin B1 (thiamine hydrochloride) at 1.4 mg, Vitamin B6 (pyridoxine hydrochloride) at 0.9 mg, Vitamin D3 (cholecalciferol) at 200 IU, and Vitamin B12 (cyanocobalamin) at 0.8 mcg. Each serving size is 240 ml, providing 90 kcal, 50 mg of sodium, and 23 g of total carbohydrates.

Table 3. Ingredients, and Nutritional Facts of the Pre-workout Intake

Ingredients	Nutritional facts
Carbonated Water, Sugar, Acidity Reg3ulators (Citric Acid and Sodium Citrate), Taurine, Caffeine (131mg), Natural and Artificial Flavors Sweeteners (Sucralose and Acesulfarne Potassium), Sodium Benzonate as Preservative, Artificial Colors (Including Tartrazine), Inositol, Ginseng Powder, Vitamins and Mineral (Vitamin B3, Zinc Sulfate, Vitamin B1, Vitamin B6, Vitamin D3, and Vitamin B12)	Serving Size: 240 ml Calories, 90kcal Sodium 50mg Total Carbohydrates 23g Thiamine Hydrochloride 1.4mg Zinc 5.4 mg Cholecalciferol 200IU Niacinamide 8.0 mg Pyridoxine Hydrochloride .9mg Cyanocobalamin .8 mcg

Front crawl swimming performance testing.

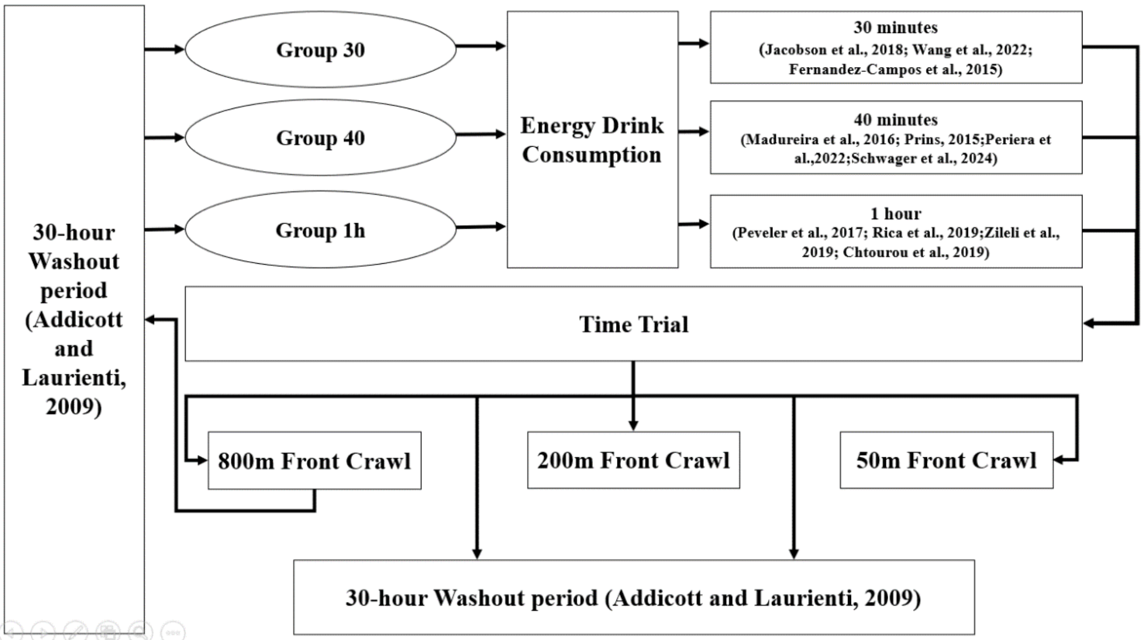
The testing was done in an Olympic-standard swimming pool. Each participant individually underwent a rigorous data gathering procedure. Participants were asked to cease consumption of caffeinated foods 30 hours prior to the testing. Also, they were suggested to stop engaging to moderate to vigorous physical activities. These were done to set the standardization of the physiological aspect of the participant. The study required the participant to consume an energy drink. After that, the participant observed for the group's designated time to begin the 50-meter front crawl. Lastly, the participant was administered by a time trial of the 50-meter swim using a front crawl. This concluded the first day of the testing. The second testing was administered after more than 30 hours after the first testing to provide a washout on the effect of previous consumption of energy drink and testing. The second test was the same as the first, but the participant performed an 800-meter front crawl. Thirty hours later, the third test was

Editor: University of A Coruña. A Coruña. Spain
ISSN-e 2386-8333
E-mail: sportis.journal@udc.es Web: https://revistas.udc.es

Original article. Comparative analysis of three energy drink consumption timings on front crawl performance of collegiate swimmers. Vol. 11, n.º 1; p. 1-26, January 2025. https://doi.org/10.17979/sportis.2025.11.1.11220

conducted using the same protocol, incorporating a 1500-meter front crawl. All participants underwent the procedure, with the time before the start of the front crawl swimming performance varying depending on their group assignment. Figure 1 shows the data-gathering procedure of the study.

Figure 1. Data gathering procedure of the study



Data Analysis

The normality of the data was tested using the Shapiro-Wilk test. The test result revealed a p-value of 0.18, rejecting the null hypothesis. With this, the Kruskal-Wallis H test was used to compare two population means from the same group with a non-normal distribution of data (McKight and Najab, 2010). The analysis was used to compare the effect of the three different energy drink consumption timings on front crawl swimming at various events.

Potential Ethical Issues

Initial approval was obtained from the College of Sport, Exercise, and Recreation, Bulacan State University's local ethics committee before proceeding with data collection. The participants were given a comprehensive briefing on the study, which included a discussion about their rights within the study context. Afterward, individuals were asked to provide informed consent by completing a consent letter.

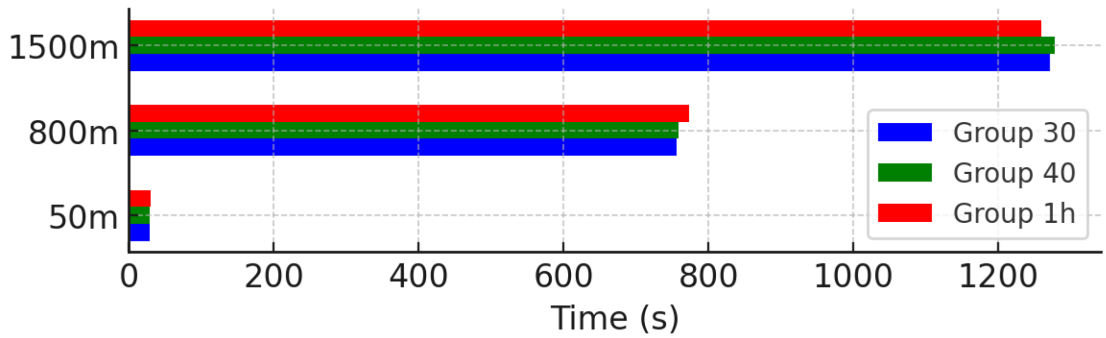
Sportis Revista Técnico-Científica del Deporte Escolar, Educación Física y Psicomotricidad
Scientific Technical Journal of School Sport, Physical Education and Psychomotricity
Editor: University of A Coruña. A Coruña. Spain
ISSN-e 2386-8333
E-mail: sportis.journal@udc.es Web: https://revistas.udc.es

Subsequently, a Physical Readiness Questionnaire was administered to ascertain the presence of any concealed medical conditions among the subjects. To conclude, it is essential to emphasize that the acquired data was handled with utmost confidentiality and disclosed to the owner upon their request.

Results

Table 4 shows the between-group comparison of energy drink consumption timings on all participants' front crawl performance.For the 50-meter front crawl performance, Group 30 had a median time of 29.10 seconds (IQR: 2.50), Group 40 had a median time of 28.70 seconds (IQR: 2.60), and Group 1h had a median time of 29.35 seconds (IQR: 2.30). The Kruskal-Wallis H test showed no statistically significant difference between groups, H(2) = 0.64, p = 0.73.For the 800-meter front crawl performance, Group 30 had a median time of 755.0 seconds (IQR: 25.0), Group 40 had a median time of 759.0 seconds (IQR: 30.0), and Group 1h had a median time of 774.0 seconds (IQR: 24.0). The test result was H(2) = 4.35, p = 0.11, indicating no significant difference between the groups.For the 1500-meter front crawl performance, Group 30 had a median time of 1273.0 seconds (IQR: 38.0), Group 40 recorded 1276.0 seconds (IQR: 37.0), and Group 1h recorded 1260.0 seconds (IQR: 35.0). The Kruskal-Wallis test showed H(2) = 1.94, p = 0.38, indicating no statistically significant differences between the groups.In conclusion, the between-group comparison of various front crawl performances was found to be insignificant across all groups. Thus, the hypothesis (H1) that there would be no significant differences in performance based on energy drink consumption timing was accepted.

Table 4 All participants between-group comparison of consumption timings on Front Crawl Performance

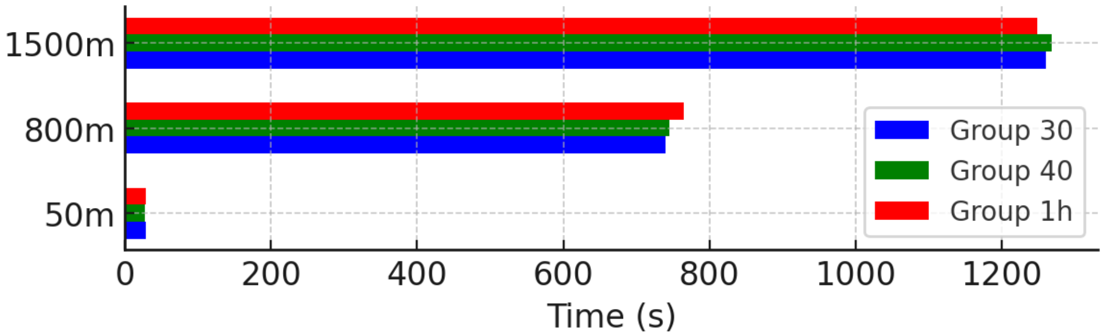


Editor: University of A Coruña. A Coruña. Spain
ISSN-e 2386-8333
E-mail: sportis.journal@udc.es Web: https://revistas.udc.es

Events	Group 30	Group 40	Group 1h	*h-value*	*P value*
50m	29.12±2.78 s	28.67±2.53 s	29.38±2.29 s	.64	.73
800m	755.99±28.46 s	759.34±31.80 s	773.94±25.33 s	4.35	.11
1500m	1272.08±37.64 s	1277.80±37.90 s	1259.73±36.57 s	1.94	.38

Table 5 shows the between-group comparison of energy drink consumption timings on male participants' front crawl performance.For the 50-meter front crawl performance, Group 30 had a median time of 28.15 seconds (IQR: 2.50), Group 40 had a median time of 27.75 seconds (IQR: 2.50), and Group 1h had a median time of 28.25 seconds (IQR: 2.30). The Kruskal-Wallis H test showed no statistically significant difference between groups, H(2) = 0.19, p = 0.90.For the 800-meter front crawl performance, Group 30 had a median time of 739.50 seconds (IQR: 30.20), Group 40 had a median time of 745.50 seconds (IQR: 33.40), and Group 1h had a median time of 765.00 seconds (IQR: 25.00). The Kruskal-Wallis test result was H(2) = 0.36, p = 0.17, indicating no significant difference among the groups.For the 1500-meter front crawl performance, Group 30 had a median time of 1260.60 seconds (IQR: 19.90), Group 40 recorded 1268.40 seconds (IQR: 27.00), and Group 1h recorded 1249.30 seconds (IQR: 33.10). The Kruskal-Wallis test showed H(2) = 2.10, p = 0.35, indicating that there were no statistically significant differences between the groups.In conclusion, the between-group comparison of various front crawl performances was found to be insignificant across all groups. Therefore, the hypothesis (H1) that there would be no significant differences in performance based on energy drink consumption timing was accepted.

Table 5 Male participants between-group comparison of consumption timings on Front Crawl Performance



Sportis. Revista Técnico-Científica del Deporte Escolar, Educación Física y Psicomotricidad
Scientific Technical Journal of School Sport, Physical Education and Psychomotricity

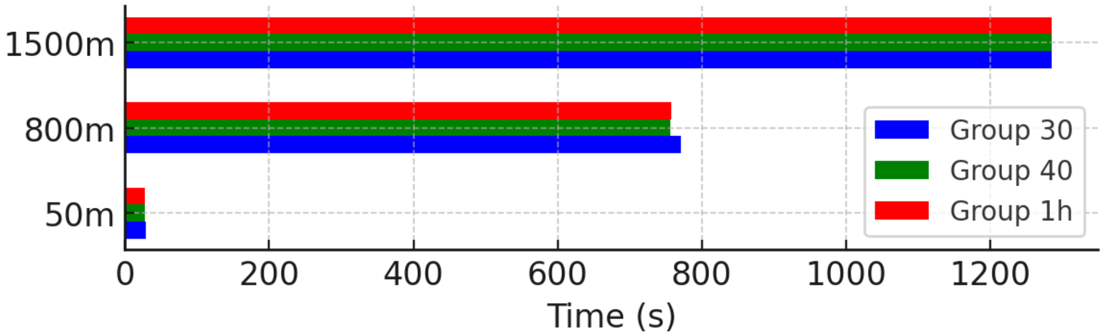
Editor: University of A Coruña. A Coruña. Spain
ISSN-e 2386-8333
E-mail: sportis.journal@udc.es Web: https://revistas.udc.es

Events	Group 30	Group 40	Group 1h	*h-value*	*P value*
50m	28.16±2.53 s	27.74±2.49 s	28.26±2.30	.19	.90
800m	739.53±30.24 s	745.48±33.44 s	765.02±29.09	3.6	.17
1500m	1260.62±19.91 s	1268.44±2.69 s	1249.33±33.10	2.1	.35

Table 6 shows the between-group comparison of energy drink consumption timings on male participants' front crawl performance.For the 50-meter front crawl performance, Group 30 had a median time of 29.10 seconds (IQR: 1.80), Group 40 had a median time of 27.80 seconds (IQR: 2.20), and Group 1h had a median time of 28.00 seconds (IQR: 2.75). The Kruskal-Wallis H test showed no statistically significant difference between groups, H(2) = 0.75, p = 0.69.For the 800-meter front crawl performance, Group 30 had a median time of 771.50 seconds (IQR: 28.60), Group 40 had a median time of 756.70 seconds (IQR: 28.90), and Group 1h had a median time of 757.60 seconds (IQR: 27.00). The test result was H(2) = 0.85, p = 0.65, showing no significant difference between the groups.For the 1500-meter front crawl performance, Group 30 had a median time of 1284.80 seconds (IQR: 25.80), Group 40 recorded 1284.80 seconds (IQR: 30.10), and Group 1h recorded 1284.80 seconds (IQR: 37.60). The Kruskal-Wallis test showed H(2) = 2.37, p = 0.31, indicating no statistically significant differences between the groups.In conclusion, the between-group comparison of various front crawl performances was found to be insignificant across all groups. Therefore, the hypothesis (H1) that there would be no significant differences in performance based on energy drink consumption timing was accepted.

Sportis Revista Técnico-Científica del Deporte Escolar, Educación Física y Psicomotricidad
Scientific Technical Journal of School Sport, Physical Education and Psychomotricity
Editor: University of A Coruña. A Coruña. Spain
ISSN-e 2386-8333
E-mail: sportis.journal@udc.es Web: https://revistas.udc.es

Table 6 Female participants between-group comparison of consumption timings on Front Crawl Performance



	Group 30	Group 40	Group 1h	*h-value*	*P value*
50m	29.09±1.78 s	27.81±2.23 s	28.04±2.75	.746	.69
800m	771.51±28.64 s	756.69±28.87 s	757.61±27.04	.854	.65
1500m	1284.85±25.83 s	1284.85±30.11s	1284.85±37.64	.2.37	.31

Discussion

The study has limitations in its comparative analysis of the mentioned energy drink consumption timing. First, the selection of the timings was based on previous studies about energy drink consumption and athletic performance. The principle of individuality was not considered in this study. Secondly, as for the dependent variable, only the front crawl was subjected to investigation. This can provide an incomplete view of how the mentioned timings compare. Third, the performance details were enclosed in the time record of the participants at the mentioned distances. The study did not focus on performance indicators such as cardiovascular endurance and muscle fitness, which are composed of power, strength, and endurance. The mentioned limitations of the present study can set a direction for further understanding of the causal relationship between the investigated variables.

The 50m, 800m, and 1500m energy drink-induced front crawl performances of the participants were compared. The locally available energy drinks were consumed by the participants. After this, they were asked to wait for their respective assigned times before doing the time trials of different front crawl events. The data were analyzed

Editor: University of A Coruña. A Coruña. Spain
ISSN-e 2386-8333
E-mail: sportis.journal@udc.es Web: https://revistas.udc.es

using the Kruskal-Wallis H test to determine which consumption timing was superior in terms of improving various front crawl performances.

Among all of the participants, despite sex, there was an insignificant difference in the 50m, 800m, and 1500m front crawl performances among the three energy drink consumption timings. With this, H_1 was accepted.The results of the study open an avenue for discussion of the optimal timing of energy drink consumption in relation to front crawl performance. However, this authenticity begets insufficient supporting studies to validate the result of the study. With this, further studies were recommended to be done using the variables of the studies. A study supports the conclusions of the present study. It was well studied that energy drinks can increase cardiovascular fitness by ingesting them 20 minutes prior to an activity. However, immediate consumption and 20 minutes before physical activity timings of ingestion do not significantly differ from improving the said fitness parameter (Kumar et al., 2017). The principle of individuality plays an important role in explaining the result of the present study. Individuality refers to the difference in the biological makeup of an individual, which can affect how the body reacts to drugs. With this, understanding the genetic differences can help optimize energy drink consumption, maximizing benefits and decreasing risk (Gutiérrez-Hellín & Varillas-Delgado, 2021). The genetic variants of the participants may influence the metabolic reaction to the energy drink, aside from the different energy drink consumption timing. Lastly, the metabolic rate is also a factor in determining the effectiveness of the energy drink (Harty et al., 2020). The study also has a limitation on the caffeine intake with respect to the body mass of the participants, as the energy drink used in the study has 131 mg among all the participants. This can be another reason for the insignificant difference among the different consumption timings. It was recommended that 3-6 milligrams of caffein be given per kilogram of body mass (International Society of Sports Nutrition, 2018). In conclusion, while the study found no significant differences in front crawl performance based on the timing of energy drink consumption, further research is necessary to validate these findings and consider individual genetic and metabolic variations, as well as appropriate caffeine dosages relative to body mass, to optimize the benefits of energy drink consumption for athletic performance.

Original article. Comparative analysis of three energy drink consumption timings on front crawl performance of collegiate swimmers. Vol. 11, n.º 1; p. 1-26, January 2025. https://doi.org/10.17979/sportis.2025.11.1.11220

As for male participants, there was an insignificant difference in the 50m, 800m, and 1500m front crawl performances among the three energy drink consumption timings. This was also the case for the female participants. As a conclusion, H_1 was accepted.There was an insignificant difference in front crawl performance among the consumption timings. The sex of the participants can also be a factor in the insignificant difference between the three consumption times. Considering sex-specific characteristics is crucial when utilizing energy beverages as pre-workout supplements, as advised. The divergent impact of energy drinks on males and females arises from disparities in hormone levels, body composition, and metabolic rates (Chaudhry et al., 2022). Studies have shown that hormonal fluctuations, particularly in females, might influence the body's response to caffeine and other stimulating compounds found in energy drinks. These findings have the potential to impact both performance and cardiovascular responses (Smith et al., 2019; Brown et al., 2021). In addition, variations in body composition, such as increased fat content in females and greater muscle mass in males, might impact the way active chemicals in energy drinks are absorbed, distributed, and metabolized (Jones & Williams, 2018; Kumar et al., 2020). Furthermore, the metabolic rate, which tends to be higher in males, can impact the efficacy and longevity of the performance-enhancing advantages provided by these beverages (Gutiérrez-Hellín & Varillas-Delgado, 2021; Harty et al., 2020). In order to enhance athletic performance and guarantee the safety of commonly used pre-workout supplements, it is crucial to understand the physiological and metabolic distinctions between males and females. This comprehension enables customized consumption of energy drinks, thereby reducing potential hazards and improving overall efficacy (International Society of Sports Nutrition, 2018; Chaudhry et al., 2022). In conclusion, recognizing and accommodating the physiological and metabolic differences between males and females is essential for optimizing energy drink consumption as pre-workout supplements to enhance athletic performance and ensure safety.

Conclusion

The study concluded that the three energy drink consumption timings namely 30 minutes, 40 minutes, and 1 hour do not differ in terms of their effect on 50m, 800m, and 1500m front crawl swimming performance among swimmers despite their sex. Future

Editor: University of A Coruña. A Coruña. Spain
ISSN-e 2386-8333
E-mail: sportis.journal@udc.es Web: https://revistas.udc.es

researchers were suggested to replicate the study to validate the result of the present study.

References:

Addicott, M., & Laurienti, P. (2009). A comparison of the effects of caffeine following abstinence and normal caffeine use. *Psychopharmacology, 207*, 423-431. https://doi.org/10.1007/s00213-009-1668-3

Arazi, H., Najafdari, A., & Eghbali, E. (2016). Effect of Big Bear energy drink on performance indicators, blood lactate levels and rating of perceived exertion in elite adolescent female swimmers. *Progress in Nutrition, 18*, 403-410.

Arent, S. M., Cintineo, H. P., McFadden, B. A., Chandler, A. J., & Arent, M. A. (2020). Nutrient Timing: A Garage Door of Opportunity?. *Nutrients*, *12*(7), 1948. https://doi.org/10.3390/nu12071948

Barbosa, T. M., Chen, S., Morais, J. E., Costa, M. J., & Batalha, N. (2018). The changes in classical and nonlinear parameters after a maximal bout to elicit fatigue in competitive swimming. *Human movement science*, *58*, 321–329. https://doi.org/10.1016/j.humov.2017.12.010

Bixler, B., Pease, D., & Fairhurst, F. (2014). The accuracy of computational fluid dynamics analysis of the passive drag of a male swimmer. *Sports Biomechanics, 6*(1), 81-98. https://doi.org/10.1080/14763140608522859

Brown, J., & Smith, L. (2021). Hormonal fluctuations and their impact on caffeine metabolism in women. *Journal of Sports Medicine, 58*(4), 334-345. https://doi.org/10.1016/j.jsm.2021.02.014

Buxton, C., & Hagan, J. (2012). A survey of energy drinks consumption practices among student-athletes in Ghana: Lessons for developing health education intervention programmes. *Journal of the International Society of Sports Nutrition, 9*, 9-9. https://doi.org/10.1186/1550-2783-9-9

Chaudhry, S., Iqbal, S., Kareem, M. A., Amanat, A., & Fatima, J. (2022). Effect of energy drinks consumption on physical performance: Beneficial and adverse impact on health. *South Asian Research Journal of Pharmaceutical Sciences,* *4*(2), 22-27. https://doi.org/10.36346/sarjps.2022.v04i02.001

Chtourou, H., Trabelsi, K., Ammar, A., Shephard, R., & Bragazzi, N. (2019). Acute effects of an "energy drink" on short-term maximal performance, reaction times, psychological and physiological parameters: Insights from a randomized double-blind, placebo- controlled, counterbalanced crossover trial. *Nutrients, 11*. https://doi.org/10.3390/nu11050992

Cohen, R. C., Cleary, P. W., Harrison, S. M., Mason, B. R., & Pease, D. L. (2014). Pitching effects of buoyancy during four competitive swimming strokes. *Journal of applied biomechanics*, *30*(5), 609–618. https://doi.org/10.1123/jab.2013-0260

Cornis, S., McBreairty, L. E., Chilibeck, P., & Zello, G. (2016). Fat metabolism during exercise and dietary interventions for enhancing fat metabolism and athletic performance. *Metabolism: Clinical and Experimental, 59*(2), 267-274. https://doi.org/10.1016/j.metabol.2009.07.023

Décombaz, J., Schmitt, B., Ith, M., Decarli, B., Diem, P., Kreis, R., Hoppeler, H., & Boesch, C. (2001). Postexercise fat intake repletes intramyocellular lipids but no faster in trained than in sedentary subjects. *American Journal of Physiology. Regulatory, Integrative and Comparative Physiology, 281*(3), R760–R769. https://doi.org/10.1152/ajpregu.2001.281.3.R760

Droste, N., Tonner, L., Zinkiewicz, L., Pennay, A., Lubman, D. I., & Miller, P. (2014). Combined alcohol and energy drink use: motivations as predictors of consumption patterns, risk of alcohol dependence, and experience of injury and aggression. *Alcoholism, clinical and experimental research*, *38*(7), 2087–2095. https://doi.org/10.1111/acer.12438

El-Sabban, F. (2016). Energy drinks and human body physiology. *MOJ Anatomy & Physiology, 2*, 1-3. https://doi.org/10.15406/MOJAP.2016.2.00058

Fernández-Campos, C., Dengo, A. L., & Moncada-Jiménez, J. (2015). Acute Consumption of an Energy Drink Does Not Improve Physical Performance of

Female Volleyball Players. *International journal of sport nutrition and exercise metabolism*, *25*(3), 271–277. https://doi.org/10.1123/ijsnem.2014-0101

Galloway, S., Lott, M. E. J., & Toulouse, L. C. (2014). Preexercise carbohydrate feeding and high-intensity exercise capacity: Effects of timing of intake and carbohydrate concentration. *International Journal of Sport Nutrition and Exercise Metabolism, 24*(3), 258-266. https://doi.org/10.1123/ijsnem.2013-0119

George, A. B., & Westneat, M. W. (2019). Functional morphology of endurance swimming performance and gait transition strategies in balistoid fishes. *The Journal of experimental biology*, *222*(Pt 8), jeb194704. https://doi.org/10.1242/jeb.194704

Gutiérrez-Hellín, J., & Varillas-Delgado, D. (2021). Energy drinks and sports performance, cardiovascular risk, and genetic associations; future prospects. *Nutrients, 13*(3), Article 715. https://doi.org/10.3390/nu13030715

Harty, P. S., Stratton, M. T., Escalante, G., Rodriguez, C., Dellinger, J. R., Williams, A. D., White, S. J., Smith, R. W., Johnson, B. A., Sanders, M. B., & Tinsley, G. M. (2020). Effects of Bang® Keto Coffee Energy Drink on Metabolism and Exercise Performance in Resistance-Trained Adults: A Randomized, Double-blind, Placebo-controlled, Crossover Study. *Journal of the International Society of Sports Nutrition*, *17*(1), 45. https://doi.org/10.1186/s12970-020-00374-5

Helge, J. W., Watt, P. W., Richter, E. A., Rennie, M. J., & Kiens, B. (2001). Fat utilization during exercise: Adaptation to a fat-rich diet increases utilization of plasma fatty acids and very low-density lipoprotein-triacylglycerol in humans. *The Journal of Physiology, 537*(1), 1009-1020. https://doi.org/10.1111/j.1469-7793.2001.01009.x

Hetzler, R., Stickley, C., Lundquist, K., & Kimura, I. (2008). Reliability and accuracy of handheld stopwatches compared with electronic timing in measuring sprint performance. *Journal of Strength and Conditioning Research, 22*, 1969-1976.

Editor: University of A Coruña. A Coruña. Spain
ISSN-e 2386-8333
E-mail: sportis.journal@udc.es Web: https://revistas.udc.es

https://doi.org/10.1519/JSC.0b013e318185f36c

Hoffman, J. (2007). Protein intake: Effect of timing. *Strength and Conditioning Journal, 29*(3), 26-34. https://doi.org/10.1519/1533-4295(2007)29[26:PIEOT]2.0.CO;2

Hutchison, A. (2022). *The Swim Prescription: How Swimming Can Improve Your Mood, Restore Health, Increase Physical Fitness and Revitalize Your Life*. Hatherleigh Press.

International Society of Sports Nutrition. (2018). ISSN position stand: Caffeine and performance. *Journal of the International Society of Sports Nutrition, 15*(1), 1-15. https://doi.org/10.1186/s12970-018-0245-4

Ivy, J. L., Kammer, L., Ding, Z., Wang, B., Bernard, J. R., Liao, Y. H., & Hwang, J. (2009). Improved cycling time-trial performance after ingestion of a caffeine energy drink. *International Journal of Sport Nutrition and Exercise Metabolism, 19*(1), 61–78. https://doi.org/10.1123/ijsnem.19.1.61

Jacobson, B., Hester, G., Palmer, T., Williams, K., Pope, Z., Sellers, J., Conchola, E., Woolsey, C., & Estrada, C. (2018). Effect of energy drink consumption on power and velocity of selected sport performance activities. *Journal of Strength and Conditioning Research, 32*(6), 1613–1618. https://doi.org/10.1519/JSC.0000000000002026

Jones, S. R., & Williams, K. (2018). Body composition differences and their effects on energy drink absorption. *Journal of Applied Physiology, 125*(6), 1547-1558. https://doi.org/10.1152/japplphysiol.00395.2018

Kjendlie, Per-Ludvik & Pedersen, Tommy & Stallman, Robert. (2018). The effect of waves on the performance of five different swimming strokes. *The Open Sports Sciences Journal. 11*. 41-49. https://doi.org/10.2174/1875399X01811010041.

Kumar, N., Sharma, R., & Verma, P. (2020). Energy drinks and their ergogenic effects in males and females. *Nutrition and Health, 26*(5), 422-432.

Original article. Comparative analysis of three energy drink consumption timings on front crawl performance of collegiate swimmers. Vol. 11, n.º 1; p. 1-26, January 2025. https://doi.org/10.17979/sportis.2025.11.1.11220

https://doi.org/10.1177/0260106020937481

Kumar, N., Srivastava, D., Tiwari, N., & Dwivedi, S. (2017). Effective time for consumption of preexercise energy drink to enhance cardiorespiratory fitness. *Saudi Journal of Sports Medicine, 17*, 79-81. https://doi.org/10.4103/1319-6308.207575

Lara, B., Gonzalez-Millán, C., Salinero, J. J., Abian-Vicen, J., Areces, F., Barbero-Alvarez, J. C., Muñoz, V., Portillo, L. J., Gonzalez-Rave, J. M., & Del Coso, J. (2014). Caffeine-containing energy drink improves physical performance in female soccer players. *Amino acids*, *46*(5), 1385–1392. https://doi.org/10.1007/s00726-014-1709-z

Madureira, D., Santana, J. O., Avelar, B., de Sousa Zocoler, C. A., Rodrigues, B., & Caperuto, É. C. (2016). Energy drinks do not improve Le Parkour performance: A randomized controlled study. *Food and Nutrition Sciences, 7*(4), 338-343.

Masagca, R. C. (2024a). The AI coach: A 5-week AI-generated calisthenics training program on health-related physical fitness components of untrained collegiate Original article. *Journal of Human Sport and Exercise* , 20(1), 39- 56. https://doi.org/10.55860/13v7e679

Masagca, R. C. E. (2024b). The effect of 10-week wholebody calisthenics training program on the muscular endurance of untrained collegiate students. *Journal of Human Sport and Exercise* , 19(4), 941-953. https://doi.org/10.55860/c9byhd85

Masagca, R.C. (2024c). Comparison of low-intensity steady state training versus highintensity interval training on key health-related physical fitness components. *Journal of Physical Education and Sports*, 24(3), 488- 498. https://doi.org/10.7752/jpes.2024.03060

Marczinski, C. A., & Fillmore, M. T. (2014). Energy drinks mixed with alcohol: what are the risks?. *Nutrition reviews*, *72 Suppl 1*(0 1), 98–107.

Editor: University of A Coruña. A Coruña. Spain
ISSN-e 2386-8333
E-mail: sportis.journal@udc.es Web: https://revistas.udc.es
Sportis. Revista Técnico-Científica del Deporte Escolar, Educación Física y Psicomotricidad. Scientific Technical Journal of School Sport, Physical Education and Psychomotricity

https://doi.org/10.1111/nure.12127

Matsuo, T., & Suzuki, M. (1999). Effects of dietary composition and exercise timing on substrate utilization and sympathoadrenal function in healthy young women. *Metabolism: clinical and experimental*, *48*(12), 1596–1602. https://doi.org/10.1016/s0026-0495(99)90251-2

McConell, G. K., Kloot, K., & Hargreaves, M. (1996). Effect of timing of carbohydrate ingestion on endurance exercise performance. *Medicine and Science in Sports and Exercise, 28*(10), 1300-1304. https://doi.org/10.1097/00005768-199610000-00014

McKenzie, M. R., McKean, M. R., Doyle, D. P., Hogarth, L. W., & Burkett, B. J. (2022). Swimming performance, physiology, and post-activation performance enhancement following dryland transition phase warmup: A systematic review. *PLOS One, 17*(8), e0273248. https://doi.org/10.1371/journal.pone.0273248

McKight, P., & Najab, J. (2010). Kruskal-Wallis test. *The Encyclopedia of Research Design*, 1-1. https://doi.org/10.1002/9780470479216.CORPSY0491

Mclellan, T., & Lieberman, H. (2012). Do energy drinks contain active components other than caffeine? *Nutrition Reviews, 70*(12), 730-744. https://doi.org/10.1111/j.1753- 4887.2012.00525.x

Moore D. R. (2019). Maximizing Post-exercise Anabolism: The Case for Relative Protein Intakes. *Frontiers in nutrition*, *6*, 147. https://doi.org/10.3389/fnut.2019.00147

Morais, J. E., Barbosa, T. M., Bragada, J. A., Ramirez-Campillo, R., & Marinho, D. A. (2023). Interaction of kinematic, kinetic, and energetic predictors of young swimmers' speed. *International Journal of Sports Physiology and Performance, 1*(aop), 1-7.

Munteanu, C., Rosioru, C., Tarba, C., & Lang, C. (2018). Long-term consumption of energy drinks induces biochemical and ultrastructural alterations in the heart muscle. *Anatolian journal of cardiology*, *19*(5), 326–323.

Editor: University of A Coruña. A Coruña. Spain
ISSN-e 2386-8333
E-mail: sportis.journal@udc.es Web: https://revistas.udc.es

https://doi.org/10.14744/AnatolJCardiol.2018.90094

Nowak, D., & Jasionowski, A. (2016). Analysis of consumption of energy drinks by a group of adolescent athletes. *International Journal of Environmental Research and Public Health, 13*. https://doi.org/10.3390/ijerph13080768

Oglesby, L., Amrani, K., Wynveen, C., & Gallucci, A. (2018). Do energy drink consumers study more? *Journal of Community Health, 43*, 48-54. https://doi.org/10.1007/s10900- 017-0386-8

Pereira, J. C., Lima, L. M., Alfenas, R. C., Guttierres, A. P. M., Sillero-Quintana, M., Teis, H. H. T., & Marins, J. C. B. (2022). Consumption of energy drinks on cardiovascular and metabolic response and performance. Is there an effect? *Archivos de Medicina del Deporte, 39*(208), 94-100. https://doi.org/10.18176/archmeddeporte.00094

Peveler, W., Sanders, G., Marczinski, C., & Holmer, B. (2017). Effects of energy drinks on economy and cardiovascular measures. *Journal of Strength and Conditioning Research, 31*, 882–887. https://doi.org/10.1519/JSC.0000000000001553

Prins, P. J. (2015). The effect of energy drink ingestion on 5-km running performance in recreational endurance runners (Doctoral dissertation, University of Pittsburgh).

Rica, R., Evangelista, A., Maia, A., Machado, A., Teixeira, C., Barbosa, W., Hacbart, F., Guerra, M., Ferreira, L., Gomes, J., Mendes, R., Miranda, J., Viana, M., Baker, J., & Bocalini, D. (2019). Energy drinks do not alter aerobic fitness assessment using field tests in healthy adults regardless of physical fitness status. *Journal of Physical Education and Sport.* https://doi.org/10.7752/jpes.2019.s1017

Sanders, R. H., Takagi, H., & Vilas-Boas, J. P. (2023). How technique modifications in elite 100m swimmers might improve front crawl performances to podium levels: Swimming 'chariots of fire'. *Sports Biomechanics, 22*(12), 1532-1551.

Original article. Comparative analysis of three energy drink consumption timings on front crawl performance of collegiate swimmers. Vol. 11, n.º 1; p. 1-26, January 2025. https://doi.org/10.17979/sportis.2025.11.1.11220

Schoenfeld, B., Aragon, A., & Krieger, J. (2013). The effect of protein timing on muscle strength and hypertrophy: a meta-analysis. *Journal of the International Society of Sports Nutrition, 10*(1), 53. https://doi.org/10.1186/1550-2783-10-53

Schwager, L. E., Helwig, N. J., Rogers, E. M., Banks, N. F., Alpers, J. P., Schulte, S. L., ... & Jenkins, N. D. (2024). Novel energy drink improves cognitive function and mood, without influencing myocardial oxygen demand or ventricular repolarization in adult gamers: A randomized, double-blind, placebo-controlled, crossover trial. *Journal of the American Nutrition Association, 43*(1), 33-47.

Seifert, S. M., Schaechter, J. L., Hershorin, E. R., & Lipshultz, S. E. (2011). Health effects of energy drinks on children, adolescents, and young adults. *Pediatrics*, *127*(3), 511–528. https://doi.org/10.1542/peds.2009-3592

Simulescu, V., Ilia, G., Macarie, L., & Mergheș, P. (2019). Sport and energy drinks consumption before, during, and after training. *Science & Sports, 34*(1), 3-8. https://doi.org/10.1016/j.scispo.2018.10.002

Smith, M. A., & Johnson, R. E. (2019). Influence of sex hormones on the cardiovascular effects of caffeine. *American Journal of Physiology-Heart and Circulatory Physiology, 317*(2), H345-H353. https://doi.org/10.1152/ajpheart.00017.2019

Tambalis, K. D. (2022). The effect of electrolytes and energy drinks consumption on athletic performance – a narrative review. *European Journal of Fitness, Nutrition and Sport Medicine Studies, 3*(1). https://doi.org/10.46827/ejfnsm.v3i1.127

Viana, E., Bentley, D., & Logan-Sprenger, H. M. (2019). A physiological overview of the demands, characteristics, and adaptations of highly trained artistic swimmers: A literature review. *Sports Medicine - Open, 5,* 16. https://doi.org/10.1186/s40798-019-0190-3

Wang, J., Wei, C., Peng, Y., Wang, H., Hung, C., Hong, Y., Liou, Y., & Hou, C. (2022). Does caffeinated energy drink consumption affect endurance performance?

Sportis. Revista Técnico-Científica del Deporte Escolar, Educación Física y Psicomotricidad
Scientific Technical Journal of School Sport, Physical Education and Psychomotricity

Editor: University of A Coruña. A Coruña. Spain
ISSN-e 2386-8333
E-mail: sportis.journal@udc.es Web: https://revistas.udc.es

Frontiers in Physiology, 13. https://doi.org/10.3389/fphys.2022.999811

Zileli, R., Şemşek, Ö., Baldirlioğlu, A., Tunçeli, B., & Ip, E. (2019). Effect of the energy drink "Red Bull" on the amateur football players' aerobic and anaerobic performances. *Journal of Education and Training Studies, 7*(3). https://doi.org/10.11114/jets.v7i3.3971