Literature Review: Effectiveness of Sports Drinks on Athletes Performance

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Abstract
Sports drinks are beverages formulated to replace lost body fluids, minerals lost through sweat, and sugar as a source of energy used during physical activity. Based on their osmolarity, sports drinks are classified into three types: hypotonic, isotonic, and hypertonic beverages. The main benefit of sports drinks is to replace minerals lost through sweat during exercise, while also providing a quick source of energy for athletes experiencing fatigue. Sports drinks play an important role in maintaining blood glucose levels, fluid balance, and supporting muscle function during physical activity. However, the effectiveness of sports drinks in improving athletic performance still shows varying results, as it is influenced by differences in nutritional composition, type of sport, intensity, time of consumption, and duration of activity. This study aims to examine the effectiveness of sports drinks on athletic performance through a literature review based on research results from 2015 to 2025. The method used was a systematic analysis of a number of research articles relevant to this topic. A total of 16 articles were selected based on inclusion criteria covering theme suitability, research methods, and athletic performance parameters. The results of the study showed that of the 16 articles reviewed, 11 reported that sports drinks had a positive effect on athletic performance. In general, the consumption of sports drinks has been proven to help maintain body hydration, maintain blood glucose levels, delay muscle fatigue, and speed up recovery after strenuous exercise. Carbohydrate-electrolyte content in concentrations of 6–8% is considered most effective for supporting long-duration physical activity of moderate to high intensity. In addition, a combination of nutrients such as sodium, potassium, and a small amount of protein can increase fluid retention and prevent performance decline due to dehydration. However, the effectiveness of sports drinks also depends on the athlete's initial energy status, type of exercise, and environmental conditions such as temperature and humidity. Excessive consumption can cause electrolyte imbalance or digestive problems. Therefore, the use of sports drinks needs to be tailored to individual needs and the type of sport being played. In conclusion, sports drinks make a significant contribution to maintaining athletes' performance, endurance, and hydration status, making them an important nutritional strategy for supporting optimal performance during training and competition.

Introduction

A sports drink is a beverage formulated to replace lost body fluids, minerals lost through sweat, and sugar as an energy source used during activity (Supriyatin, 2019). An athlete's performance in competitive sports is highly dependent on strength, speed, and physical endurance, which are supported by energy from carbohydrates, hydration, and electrolytes (Amin, 2018). Sports drinks are designed to replace fluids, electrolytes (such as sodium and

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potassium), and carbohydrates (4-8% glucose/fructose) lost during physical activity, helping to maintain blood glucose levels, prevent hypoglycemia, and maintain body fluid balance (Burke et al., 2021).

In addition, exercise can trigger oxidative stress due to an imbalance between free radical production and the body's antioxidant capacity, which reduces performance and has the potential to cause cell and tissue damage, as well as degenerative diseases. Antioxidants play a role in neutralizing free radicals by donating electrons to stabilize oxidant compounds, thereby helping to maintain metabolic balance during exercise (Luthfi et al., 2023). Therefore, an ideal sports drink should not only replenish fluids and electrolytes but also contain natural antioxidants to protect the body from oxidative damage. The introduction to a research article should include the background, identification of the problem or issue that arises, then validate the problem with evidence or a strong foundation and rationale, along with the objectives, benefits, and a review of previous research without subheadings.

Although commonly used, the effectiveness of sports drinks on athletes performance is still debated. Some studies show significant benefits, such as a 10-15% increase in endurance during intense exercise, reduced muscle fatigue, and prevention of dehydration, which can reduce performance by 20-30%. However, inconsistent results arise due to variations in composition, type of sport, intensity, time of consumption, and excessive dosage, which can cause digestive problems or suboptimal use. The lack of comprehensive studies on aspects such as aerobic endurance, anaerobic strength, and post-exercise recovery is a major problem, especially in the era of intensive and global sports (Jeukendrup, 2017). The purpose of this review is to examine the effectiveness of sports drinks based on previous research, identify influencing factors (composition, type of exercise, intensity, timing, duration), and provide evidence-based recommendations for athletes, coaches, and nutritionists (Burke et al., 2021).

Previous studies have shown positive benefits: a study on triathletes found a 12% increase in aerobic endurance with a 6% carbohydrate sports drink over 90 minutes, and up to a 20% increase in muscle strength in intensive training. However, neutral or insignificant results were seen in short-duration sports such as sprinting, where plain water is sufficient. Gaps in methodology, population (elite vs. recreational), and control variables necessitate this literature review to consolidate findings and identify consistent patterns of effectiveness (Affandhy et al., 2025).

Overall, sports drinks are effective under specific conditions, but scientific understanding is needed for optimization, preventing health risks, and enhancing athletes performance. This review serves as a reference for further research and practical guidance.

Methods

This This study uses a literature review-based data analysis method that focuses on the effectiveness of sports drinks on athletes performance. A literature review is a form of secondary study derived from previous studies, commonly used in medical research. The purpose of a literature review is to identify, evaluate, and interpret all literature relevant to the research question being studied. Meanwhile, a systematic literature review serves to summarize existing evidence, identify research gaps, and provide recommendations for future research (Fauzi et al., 2019).

The data collection process was carried out by searching for research articles electronically through Google Scholar, using criteria of suitability with the research objectives and publication time frame between 2015 and 2025. The articles used consisted of 16 publications in Indonesian and English that were accessible in full text in PDF format. The stages of conducting a literature review included: topic selection, argument framework development, article search, literature review, literature critique, and review writing (Alahmadi, 2020).

Results and Discussion

The article search was conducted in a database using the keywords sport drink, electrolyte beverage, athletic performance, rehydration, hydration status, and exercise performance. The following is a list of 16 journals found and described in tabular form.

Table 1. List of Article

No	Researchers	Research methods	Results
1.	Effect of different sports drink compositions on endurance performance and substrate oxidation: a randomized, double-blind, placebo-controlled	This study used a randomized double-blind, placebo-controlled crossover design in 10 male athletes aged 20–45 years with a minimum endurance training of 6 hours per week. Each participant received one of four test solutions: mineral water (placebo), dextrose + sodium, dextrose + beet extract, or dextrose + amino acids (arginine & citrulline).	The results showed that the four types of drinks did not differ significantly in terms of fatigue time, power, peak VO_2, lactate, or heart rate ($p > 0.05$). Although dextrose increased blood glucose levels, it did not affect performance or energy metabolism. Dextrose-based sports drinks, including those

	crossover study in trained athletes (Sascha Ketelhut, Martin Moehle, danLaura Hottenrott, 2025)	The parameters measured included blood glucose and lactate levels, ventilation, heart rate, perceived exertion (RPE), and time to exhaustion.	with beet extract or amino acids, did not improve performance compared to mineral water in athletes with optimal glycogen reserves.
2.	Effects of skim milk and isotonic drink consumption before exercise on fluid homeostasis and time-trial performance in cyclists: a randomized cross-over study (Danniela García-Berger, Karen Mackay, Matias Monsalves-Alvarez, Carlos Jorquera, Rodrigo Ramirez-Campillo, Hermann Zbinden-Foncea and Mauricio Castro-Sepulveda 2020)	This study used a randomized crossover experimental design in 9 male cyclists aged 26.8 ± 4.78 years on average. Each participant underwent two test sessions, consuming either skim milk (SM) or an isotonic drink (SPD, Gatorade) as a pre-exercise fluid. Each drink was administered 350 mL at 180 minutes and 90 minutes before an 18.6 km time trial on a mountain track (±2430 m). The parameters measured included body weight, body mass, urine color, and urine specific gravity (USG). Analysis was performed using 2-way ANOVA and paired t-tests ($p < 0.05$).	The results showed no significant difference between skim milk and isotonic drink consumption in terms of body weight, urine specific gravity, urine color, water consumption, or race time ($p > 0.05$). Both beverages caused a weight loss of approximately 2.1 ± 0.48% due to fluid loss, without causing digestive disturbances. The study states that skim milk has the same effectiveness as isotonic beverages as a pre-exercise drink, making it a safe and efficient hydration alternative for athletes.
3.	The Effects of Fluid Absorption and Plasma Volume Changes in Athletes Following Consumption of Various Beverages (Hyo-Jun Yun, Ji-Yong Lee, Minsoo Jeon, Sang-eun Oh, Jae-Hyeon Park and Jiwun Yoon, 2022)	This study used a crossover design to compare the hydration effects of four beverages: water, oral rehydration solution (ORS), and two sports drinks (SpD1 and SpD2). A total of 31 male college athletes (age (years) 20.1 ± 1.14, height (cm)) participated in the experiment once a week for four weeks, each consuming 1 liter of beverage within 30 minutes. Urine samples were collected up to 4 hours after consumption, and blood samples up to 3 hours after consumption. The parameters measured included body weight, cumulative urine volume, Beverage Hydration Index (BHI), and plasma volume change (PVC). Analysis was performed using repeated measures ANOVA and LSD post-hoc test ($p < 0.05$).	The results showed that ORS and two types of sports drinks (SpD1 and SpD2) were more effective in maintaining hydration than water ($p < 0.05$). All three resulted in lower weight loss and urine output, as well as higher Beverage Hydration Index (BHI) values than water. Among all beverages, ORS had the best hydration effect, but SpD1 and SpD2 were also effective in maintaining body fluid balance. There were no significant differences in plasma volume change (PVC) between beverages.
4.	The Effect of Carbohydrate Beverage Ingestion on Central versus Peripheral Fatigue: A Placebo-Controlled, Randomized Trial in Cyclists. (Beth W. Glace, Ian J. Kremenic, Malachy P. McHugh, 2019)	This study used a double-blind randomized cross-over design to assess the effect of carbohydrate (CHO) beverages on central and peripheral fatigue in 20 trained cyclists (10 men, 10 women). Each participant underwent two test conditions, namely CHO and placebo (PL), with a 2-hour cycling test at 65% VO_2, interspersed with five 1-minute sprints, followed by a 3 km time trial and cycling to exhaustion. Muscle strength was measured before, after TT, and after exhaustion using MVC, magnetic femoral nerve stimulation (CAR), and peripheral stimulation. Data were analyzed using repeated measures ANOVA ($\alpha = 0.05$).	The results showed that muscle strength decreased by approximately 17–18% in all participants regardless of beverage type, and there was no significant peripheral fatigue. However, in men, consumption of carbohydrate (CHO) beverages reduced the decrease in central activation (CAR) and improved performance in the 3 km test compared to placebo, while in women there was no significant effect. Thus, CHO helps maintain central fatigue and performance in men, but has no effect on women.
5.	The influence of a 12 per cent carbohydrate-electrolyte beverage on self-	This study used a randomized crossover design involving 15 male university soccer players with >1 year of experience. Each participant underwent three test conditions:	The results of the study show that a 12% carbohydrate-electrolyte (CHO) drink improves physical and technical performance compared to water and placebo.

	paced soccer-specific exercise performance (Liam D. Harper, Emma J. Stevenson, Ian Rollo, Mark Russell, 2017)	water (WAT), placebo-electrolyte (PL), and 12% carbohydrate-electrolyte drink (CHO), with a minimum interval of 7 days. The drinks were administered 250 mL at the end of warm-up and 250 mL at halftime. A 90-minute match simulation was conducted using Soccer Match Simulation (SMS). The parameters measured included blood glucose and lactate levels, 15 m sprint speed, jump (CMJ), dribbling speed, number of accelerations/decelerations, RPE, and abdominal discomfort. The data were analyzed using repeated measures ANOVA ($p < 0.05$).	CHO increases blood glucose levels before and during exercise, although it decreases by 27% at the 60-minute mark. Players who consumed CHO experienced an increase in acceleration >1.5 m/s² >25%, sprint speed +2.7%, and dribbling speed >3% from the 60th minute until the end of the match. Jump height, RPE, and stomach discomfort did not differ significantly between treatments. Thus, CHO improves performance without significant side effects.
6.	Post-workout supplementation with CoQ10 and sports drink on exercise performance and muscle recovery after exercise in normal and overweight males (Phyo Pyae Thar, Teerarat Likitwattanasade, Ratchakrit Srikuea, 2025)	This study used a randomized crossover design in 42 young adult men, divided based on normal BMI (18.5–22.9 kg/m²) and overweight (23–24.9 kg/m²). Each participant underwent three treatments: placebo (flavored water), Coenzyme Q10 (300 mg ubiquinol), and sports drink (250 mL lemon Gatorade). Participants performed 75% 1RM resistance training followed by 3 minutes of all-out cycling to exhaustion, with supplements administered 10 minutes after training and training repeated 1 hour later. Measured parameters included exercise volume, peak and critical power, fatigue index, blood pressure, heart rate, urinary potassium and creatinine levels, and delayed onset muscle soreness (DOMS) up to 7 days. Data were analyzed using two-way repeated measures ANOVA ($p < 0.05$).	The results showed that the overweight group had lower exercise performance than the normal group. CoQ10 supplementation and sports drinks increased resistance exercise volume in both groups and increased critical power only in the normal group. CoQ10 lowered urinary potassium and creatinine levels and reduced delayed onset muscle soreness (DOMS) on days 1 and 3, indicating reduced muscle damage and accelerated recovery. There were no significant differences in blood pressure, heart rate, and fatigue index. Overall, CoQ10 and sports drinks improved muscle performance and recovery, with CoQ10 also effectively reducing muscle damage and pain in all participants.
7	Investigating The Effect Of Isotonic Sports Drink On Female Football Players' Physical And Mental Performance (Safa Aslam, Yasmeen Tabassum, Amna Javaid, Nazia Nazir, Hurria Hussein, Badar Mohy ud Din, Muhammad Abdul Jabar Adnan, Muhammad Zafar Iqbal Butt, 2024)	This study used a randomized single-blind placebo-controlled crossover design to assess the effect of isotonic drinks on physical and mental performance in 30 female soccer players. Participants were divided into an experimental group (drinking 1000 mL of Gatorade during the game) and a control group (placebo). Physical performance was measured through a 20 m sprint, Illinois Agility Test, and Yo-Yo Intermittent Recovery Test, while psychological conditions were assessed using the POMS questionnaire. Data were analyzed using paired and independent t-tests ($p < 0.05$	The results of the study show that consumption of isotonic drinks improves the physical performance and mental condition of female soccer players. The group that drank isotonic drinks experienced increased sprint speed, agility, and endurance, with hydration remaining stable without significant changes. In contrast, the control group did not show any significant changes. In addition, mood (POMS) was more positive in the isotonic group. Overall, isotonic drinks improve performance, maintain hydration, and improve mental condition during high-intensity activities.
8	Exercise With Fasting Or Isotonic Drink? A Randomized Controlled Trial In Youth Elite Basketball Players (Petra Márton, Luca Kata Bátai, Titanilla Takács,	This study used a randomized controlled trial to assess the effect of isotonic drinks before exercise on cardiopulmonary and metabolic responses in 71 elite youth basketball players (aged 15.9 ± 1.8 years). Participants were divided into an isotonic group (400 mL of Gatorade with 7% carbohydrates) and a fasting group (400 mL of mineral water). The drinks were administered 30	The results showed that consuming isotonic drinks 30 minutes before exercise increased blood glucose levels, reduced subjective fatigue, and delayed lactate accumulation in adolescent basketball players. There were no significant differences in VO_2max or cardiopulmonary parameters between groups. Thus, isotonic

	Emese Csulak, Anna Réka Kiss, Bence Kopper, Liliána Erzsébet Szabó, Dorottya Balla, Iván Petrov, Lilla Lázára, Hajnalka Vágó, Béla Merkely, and Nóra Sydó, 2025)	minutes before the CPET test. The parameters measured included VO_2max, heart rate, ventilation, RER, blood glucose and lactate levels, and subjective fatigue (Borg scale) every two minutes. The data were analyzed using paired t-tests and linear regression ($p < 0.05$).	drinks provide beneficial metabolic effects without significantly affecting aerobic capacity.
9	The Effects of Sports Drinks During High-Intensity Exercise on the Carbohydrate Oxidation Rate Among Athletes: A Systematic Review and Meta-Analysis (Xudong Li, Wanxia Wang, Rui Guo, Anqi Wang, Chaojun Wei, 2020) (Li et al., 2020)	A systematic review and meta-analysis of 5 randomized crossover studies with a total of 58 participants. Literature searches were conducted in the PubMed, Embase, and Cochrane databases up to November 2019. Analysis used a random-effects model with heterogeneity measures. .	Sports drinks generally did not show a significant effect on carbohydrate oxidation (CHO-O) and fat oxidation (Fat-O) compared to the control. However, carbohydrate-electrolyte solutions significantly increase carbohydrate oxidation (WMD=0.47; p=0.020) and are considered effective in maintaining energy availability during intense exercise, thereby supporting athletic performance (Li et al., 2020). Caffeine has a borderline effect on fat oxidation. Studies show heterogeneity and limitations in sample size. Larger studies are recommended for further research.
10	The Effects of Energy Drink Consumption on Cognitive and Physical Performance in Elite League of Legends Players (Casey J. Thomas, Jeffrey Rothschild, Conrad P. Earnest, dan Aaron Blaisdell, 2019)	The study used a randomized, double-blind, placebo-controlled crossover design on 9 male elite League of Legends (LoL) players with an average age of 21 years and a BMI of 25.6. Participants consumed AI Reload energy drinks or placebos in two separate visits. Cognitive tests (Eriksen Flanker Test, Go/No-Go, n-back test) and physical tests (hand grip strength, finger tap speed) were conducted before and after playing three consecutive LoL games. Analysis was performed using repeated-measures ANOVA	No significant differences were found between energy drinks and placebos in most cognitive and physical parameters (attention, reaction time, grip strength, finger tapping speed). However, there was a significant improvement in working memory (n-back test) in the energy drink group within the group, with no differences between groups. There was no significant accumulation of mental fatigue during the three LoL games. The study concluded that energy drinks did not significantly improve mental or physical performance in these elite eSports athletes.
11	Energy Drinks and Sports Performance, Cardiovascular Risk, and Genetic Associations: Future Prospects (Jorge Gutiérrez-Hellín & David Varillas-Delgado, 2021)	A literature review article examining research on the effects of caffeine and taurine in energy drinks on athletic performance, cardiovascular risk, and genetic relationships. Sources come from various clinical trials and athletic studies across different sports.	Energy drinks containing 3–6 mg/kg of caffeine and 1–6 g of taurine improve endurance, strength, and reaction performance in various sports (soccer, swimming, volleyball, athletics). However, excessive consumption can cause hypertension, arrhythmia, sleep disorders, and anxiety. The synergistic effects of caffeine and taurine are positive for performance, but pose a risk to the heart. Future research will focus on genetic polymorphisms (CYP1A2) to determine the optimal and safe dosage.
12	Sports Drinks Consumed During Exercise Which Affect Thermoregulation	A systematic review article of cross-topic randomized studies (PubMed, Medline, Web of Science, Cochrane) examining the effects of carbohydrates, electrolytes, and	Carbohydrate intake of 6–8% during exercise in the heat improves time trial and time to exhaustion (6–24% better than placebo). Cold drink temperature

	and/or Athletic Performance in the Heat: A Review (Rachel Scrivin & Katherine Black, 2018)	beverage temperature on performance and thermoregulation during exercise lasting >60 minutes at temperatures >24°C.	(10–15°C) helps lower core body temperature and improves comfort. Sodium content does not significantly affect performance, but is important to prevent dehydration >2% of body weight. It is recommended to consume isotonic drinks containing 6–8% carbohydrates + sodium during exercise in the heat.
13	Effects of Energy Drink Consumption on Physical Performance and Potential Danger of Inordinate Usage (Jakub Erdmann, Michał Wiciński, Eryk Wódkiewicz, Magdalena Nowaczewska, Maciej Słupski, Stephan Walter Otto, Karol Kubiak, Elżbieta Huk-Wieliczuk, dan Bartosz Malinowski, 2021)	This article is a literature review that analyzes various studies on the effects of energy drink (ED) consumption on physical performance and health risks due to excessive consumption. The author reviews studies with various designs, including randomized controlled trials, meta-analyses, and observational studies involving athletes, students, and adolescents. The main focus is on caffeine and taurine content and their effects on performance and metabolic, cardiovascular, and psychological risks.	The review results show that energy drink consumption can provide a small increase in physical performance such as muscle strength, endurance, and speed in several studies, especially if it contains 3–6 mg/kg of caffeine and 1–6 g of taurine. However, the synergistic effect between caffeine and taurine has not been proven to be significant, and the results between studies are inconsistent due to variations in dosage, study design, and sample population. In addition, excessive consumption of ED is associated with serious side effects, such as cardiovascular disorders (arrhythmia, hypertension, infarction), sleep disorders, anxiety, and metabolic disorders. The authors conclude that energy drinks should not be recommended for children or adolescents, and their use in adult athletes should be done with caution and at the appropriate dosage.
14	Swim drink study: a randomised controlled trial of during-exercise rehydration and swimming performance (Graham L Briars, Gillian Suzanne Gordon, Andrew Lawrence, Andrew Turner, Sharon Perry, Dan Pillbrow, Florence Einstein Walston, Paul Molyneux, 2017)	A randomized controlled multiple crossover trial was conducted on 19 competitive swimmers aged 11-17 years. Each subject underwent 12 training sessions lasting 75 minutes with different rehydration conditions: isotonic sports drink ad libitum, mineral water ad libitum, and no drink. After training, a 10 x 100 m freestyle sprint test was conducted with a 3-minute interval. The 50 m split time was measured with an electronic device. Participants were blinded to the type of drink until the session began.	The results show that drinking during exercise improves hydration, but does not improve swimming performance. There was no significant difference between the consumption of sports drinks and mineral water on swimming sprint times. Dehydration of 0.42% of body weight was not sufficient to decrease performance. The authors concluded that consuming beverages during 105 minutes of swimming did not provide physiological benefits for swimming performance in the adolescent athletes studied.
15	Role of Functional Beverages on Sport Performance and Recovery (Stefania Orrù, Esther Imperlini, Ersilia Nigro, Andreina Alfieri, Armando Cevenini, Rita Polito, Aurora Daniele, Pasqualina Buono, Annamaria Mancini, 2018)	A literature review examining the function of functional beverages enriched with macronutrients such as carbohydrates, protein, fat, and electrolytes in supporting hydration, athletic performance, and muscle recovery. Studies were taken from various experimental and clinical studies related to nutritional intake and exercise.	Functional beverages containing carbohydrates have been proven to improve endurance performance by up to 15% with a consumption of 30-60 g/hour of carbohydrates, as well as helping to delay muscle fatigue by providing readily available energy. Protein supports muscle recovery by accelerating muscle protein synthesis and reducing muscle damage. Electrolytes such as sodium are important in maintaining fluid balance and preventing dehydration. Drinks

			with the right proportions of electrolytes and macronutrients are effective for optimal hydration during exercise and accelerate recovery, especially for workouts lasting more than 3 hours. This study concludes that functional drinks play an important role in maintaining overall athlete performance and health.
16	The Hydrating Effects of Hypertonic, Isotonic and Hypotonic Sports Drinks and Waters on Central Hydration During Continuous Exercise: A Systematic Meta-Analysis and Perspective (David S. Rowlands, Brigitte Hani Kopetschny, Claire E. Badenhorst, 2022)	A systematic review and meta-analysis of 28 randomized controlled trials evaluating 68 sports drink treatments categorized as hypertonic (>300 mOsmol/kg), isotonic (275-300 mOsmol/kg), hypotonic (<275 mOsmol/kg), and water (<40 mOsmol/kg). The primary outcome measure was the change in percentage plasma volume (dPV) during continuous exercise from 0 to 180 minutes, as an indicator of central hydration.	The results of the meta-analysis show that hypotonic sports drinks provide the best central hydration during continuous exercise with the smallest decrease in plasma volume (dPV) compared to isotonic, hypertonic drinks, or water. This improved central hydration is very important because maintaining plasma volume contributes to blood circulation stability, body temperature regulation, and oxygen supply efficiency to muscle tissue during exercise. Thus, hypotonic beverages significantly support athletic performance during prolonged exercise and in hot conditions by reducing the risk of dehydration and early fatigue. Conversely, hypertonic beverages result in the greatest decrease in plasma volume, which may indicate suboptimal hydration and potentially reduce performance.

Of Based on a review of 16 journals and several literature reviews and studies related to the effectiveness of sports drinks and energy drinks on athletic performance, it can generally be concluded that the consumption of sports drinks contributes significantly to improving athletic performance and endurance, although the effects vary depending on the composition, dosage, time of consumption, and type of sport performed. The majority of studies show that sports drinks play an important role in maintaining fluid balance, maintaining blood glucose levels, and delaying fatigue during prolonged physical activity. The main components most often studied are carbohydrates and electrolytes because both play a role in providing quick energy and maintaining neuromuscular function during intensive training.

Previous studies have shown that consuming carbohydrate-electrolyte solutions before and during physical activity can stabilize blood glucose levels, delay muscle fatigue, and maintain technical performance, especially in team sports such as soccer and basketball (Harper et al., 2017; Ketelhut et al., 2025; Lisnawati et al., 2023; Márton et al., 2025). During high-intensity training, the increase in glucose levels from sports drinks helps maintain motor performance such as acceleration and sprint speed, especially in the final phase of the game when glycogen reserves begin to decline. This shows that sports drinks not only serve as a source of energy but also play a role in maintaining physiological stability during competition. Likewise, research conducted by Lestari (2024) showed that giving chia seed's sports energy drink before exercise can maintain the blood glucose levels even though it does not impact the hydration status of athletes.

Isotonic beverages have been shown to be effective in reducing subjective fatigue perception and blood lactate accumulation, contributing to improved metabolic efficiency during exercise (Márton et al., 2025). These positive effects were also found in female athletes, where consumption of isotonic drinks not only improved physical performance but also increased hydration status and mood, thereby improving focus and psychological stability during competition (Aslam et al., 2024). Thus, good hydration has a dual effect on the physiological and psychological aspects of athletes.

Several studies have not shown significant results in terms of performance improvement. Although consuming beverages with added carbohydrates or amino acids can increase blood glucose levels, this is not always followed by a significant improvement in physical ability

(Ketelhut et al., 2025). When the body's glycogen reserves are sufficient, additional pre-exercise carbohydrates do not provide any additional benefits in terms of aerobic capacity or time to exhaustion. This means that the benefits of sports drinks are optimal when muscle energy begins to decline due to prolonged and intense activity.

Sodium balance and osmolarity also play an important role in maintaining body fluid retention. Rehydration drinks with a balanced electrolyte composition have been shown to reduce urine output and improve body hydration index better than plain water (Yun et al., 2022). Similar findings were obtained with the use of skim milk containing carbohydrates and sodium, where its effectiveness in maintaining fluid homeostasis was comparable to isotonic drinks (Garciá-Berger et al., 2020). This confirms that effective hydration does not only depend on commercial products but can also be achieved through natural sources with the right electrolyte composition.

Research by (Thar et al., 2025) shows that post-workout supplementation with Coenzyme Q10 and sports drinks can increase resistance training volume and muscle strength, especially in individuals of normal weight. Thus, the combination of CoQ10 and sports drinks has the potential to accelerate muscle recovery and improve post-physical activity training performance. This combination of nutrients plays a role not only in providing energy, but also in accelerating muscle recovery and reducing the perception of fatigue. Specifically, sports drinks containing 6–8% carbohydrates, protein, and electrolytes have been shown to increase endurance performance by up to 15% and accelerate the post-exercise recovery process (Orrù et al., 2018).

During exercise in hot conditions, cold sports drinks with appropriate carbohydrate and sodium content have been shown to aid thermoregulation and prevent dehydration, thereby improving endurance (Scrivin & Black, 2018). Other studies also support the use of hypotonic beverages to achieve optimal central hydration during prolonged activities (Rowlands et al., 2022). Conversely, the effects of energy drinks containing caffeine and taurine show inconsistent results. Some studies report small increases in endurance and strength, while others find no significant differences, particularly in the cognitive and physical performance of eSports athletes (Thomas et al., 2019) (Erdmann et al., 2021)(Gutiérrez-Hellín & Varillas-Delgado, 2021). Excessive consumption of energy drinks has even been linked to the risk of cardiovascular disorders and sleep problems that need to be watched out for.

Research on adolescent athletes shows that although hydration during training can maintain physical condition, it does not always have a significant effect on improving physical performance. For example, research in swimming shows no difference in performance between consuming sports drinks and mineral water (Briars et al., 2017).

Overall, the results of this literature review confirm that the effectiveness of sports drinks is highly dependent on the type of sport, duration and intensity of exercise, initial energy status, and the physiological and psychological condition of the athlete. In sports with long duration and high intensity, consumption of carbohydrate-electrolyte drinks has been shown to provide significant benefits in maintaining performance and preventing dehydration. When the body's energy status is already optimal, the benefits are more limited to physiological stabilization. Meanwhile, energy drinks should be consumed with caution due to their potential side effects on health. Therefore, the strategy for using sports drinks needs to be individualized and contextual, tailored to the characteristics of the activity, energy status, and physiological needs of each athlete in order to maximize their benefits.

Further research is needed on the effectiveness of various sports drink compositions on athletic performance, considering the type of sport, exercise duration, and individual differences. Additionally, the use of natural ingredients as alternatives to sports drinks can be developed to support hydration and performance in a safer and more sustainable manner.

Conclusion and Recommendations

Based on a review of 16 research articles, consumption of sports drinks, especially those containing carbohydrates and electrolytes, contributes significantly to improving athletes performance and endurance, especially in sports with high duration and intensity. Interventions involving the consumption of sports drinks containing 6–8% carbohydrates, electrolytes, protein, and caffeine synergistically can delay fatigue, maintain fluid balance, and accelerate muscle recovery. However, their effectiveness is highly dependent on the type of sport, duration of exercise, the athlete's energy status, and physiological and psychological conditions. The use of energy drinks needs to be done with caution due to their side effects on health. Sports drink consumption strategies must be tailored individually and contextually to obtain optimal benefits.

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