Effect of Sports Drinks on Anaerobic Athletic Performance

Isabella Cacalano-Jordan

Mr. Jason Scott
Math Senior Seminar
May 2024

Abstract

The purpose of this study is to determine if energy drinks and sports drinks affect athletes' (high school) anaerobic performance. Previous research has looked into how energy drinks and sports drinks affect aerobic and anaerobic ability, due to the carbohydrates and electrolytes in them. We hypothesized that the sports drink and energy drink would have an effect on the athletes' sprinting results compared to the placebo. We also hypothesized that energy drinks would cause the athletes to perform more pushups and lift more weight while doing the pushups, compared to sports drinks and placebo. Eight high school athletes performed a RAST sprint test under three different conditions: placebo, energy drink, and sports drink. We found that there was no significant difference in the end between any of the drinks for any of the performance measures for the sprints or push-ups. Our data suggests that high school athletes can perform the same without any of these sports or energy drinks.

Sports drinks are known for improving the aerobic and anaerobic performance of athletes (4). Young athletes all around the world buy sports drinks, specifically in 2021 people spent around $28.26 billion on sports drinks, while in 2022 there was around $30.44 billion spent on sports drinks (1). This is important because if people are spending all this money on sports drinks it is beneficial to know if the sports drink they are buying will help the everyday athlete. Research suggests that carbohydrate-electrolyte sports drinks will affect both the endurance and anaerobic ability of an athlete. Some of the effects are from caffeine or might come from carbohydrates or electrolytes within the sports drink. The purpose of this study was to show which sports drink is the most effective for high school athletes when participating in anaerobic activities. In this study, we tested high school athletes' anaerobic ability with the RAST sprint test and a push-up test using two different sports drinks, one with caffeine, and a placebo.

Carbohydrates are molecules in food that help supply your body and brain with energy (2). Carbs are very helpful, especially for athletes when they are performing activities so that they will be able to perform to their best ability with enough energy. Electrolytes are essential minerals that help the body function properly. For everyone, but especially athletes, electrolytes are important because they help store nutrients and fluids in your body, which when exercising in activities for periods of time is essential (3).

Qazi, et al. tested ketone salt supplementation and a sports drink (Gatorade G2) with anaerobic performance and cardiorespiratory fitness in athletes, while also watching their heart rates (4). They used a triple-blind experiment where the participants received one of the two options after a one-week washout period between the two (taking a week to make sure one of the two options had been completely removed from the body). Before completing the experiment they tested the participants’ peak oxygen uptake (VO2peak). In the Wingate Test (Anaerobic) they warmed up and cycled for 15-second increments each time increasing the resistance. In the VO2peak Test (Aerobic) they had them run on the treadmill until failure. In the Wingate test, they had no differences in the two drinks. In the VO2peak test, they found no differences in the two drinks, but they found a significance in the final stage between the two drinks where the ketone salt levels were higher than in the sports drink. There was overall no improvement in anaerobic or aerobic exercise capacity after ingesting either drink

Khanna & Manna tested carbohydrate-electrolyte drinks' effect on sports performance, lactate removal, and cardiovascular response in athletes (5). They tested 10 male athletes on a treadmill with 70% max oxygen capacity in the lungs (VO2 Max). they ran until they gave up at that 70% speed. They had two phases, phase 1 was running without any supplement (carbohydrate-electrolyte drink). Phase 2 the drink is given orally during the exercise, then after the exercise during recovery. After they took an exercise at 70% of VO2 Max, as well as the heart rate, and blood samples. The carbohydrate-electrolyte drink was proven to improve athletic performance, it gave extra fuel to muscles that they use during exercise making the recovery period much better. The drink also kept the athletes’ heart rates and blood lactate levels low during exercise.

Effects on Anaerobic Power

Alamdari, et al. tested if two different energy drinks would affect the blood lactate levels and improve the athletes' anaerobic power when performing an exercise (6). Using the RAST test to test anaerobic power, they found that with the energy drink (which had carbohydrates, electrolytes, and caffeine), minimum power increased by 11%, the mean power increased by 9%, and the blood lactate decreased by 3%. However, there was no change in the sports drink and the placebo had no improvement as well. Research suggests athletes might be helped more by the caffeine in the energy drink, but it could be because of other differences in carbohydrates or electrolytes that explain the lack of help in the sports drink.

Effects on Aerobic Power

Unlike anaerobic exercise, aerobic exercise takes place over a long time and might be affected by sports drinks differently. Lee et al. tested if drinking sports drinks during and in the recovery period of exercise helps (7). They had 3 different trials to do their experiment. First, 12 male athletes did a 75 min at 65% peak ability for cycling, then 5 hours of recovery with the drink, and finally an endurance test at 65% capacity until they gave up. Researchers found that sports drinks gave them higher fluid retention, in the recovery period they had more serum sodium, higher plasma, and higher glucose in their blood, and in the second workout, they had higher endurance capacity, as well as a lower heart rate (7). This suggests that sports drinks do help endurance and recovery time. Even though we aren't testing endurance in athletes, knowing how something affects blood lactate levels and heart rate levels is still important and impactful to short-term anaerobic performance as well.

McDaniel, et al. tested how caffeine affects athletes' athletic performance. Athletes participating in activities usually consume caffeine (8). Knowing if caffeine is beneficial while exercising is very important so athletes don't consume things that aren't helpful. They looked at different previous experiments testing aerobic exercise, anaerobic exercise, and muscle glycogen. They found that skiers who consumed caffeine had 7.3% more power when skiing, and cyclists who consumed caffeine had better results as well. This study showed that caffeine with carbohydrates helps muscles refuel faster. They found that 1500m runners who consumed caffeine had a 4.2-second improvement, while swimmers with experience had around a 1-second improvement. Muscle glycogen in athletes after they consumed caffeine was 66% higher than without them consuming caffeine. This proves that caffeine is a very effective factor when participating in activities; it improves performance while completing the exercise.

Chaubey, et al. studied if water, coconut water, carbohydrate-electrolyte sports drinks, and sodium-enriched coconut drinks improved hydration and physical performance in athletes (9). This is important because if something improves a person's hydration and physical performance then it would be helpful to know about it. They were using 8 adult athletes and had them run, drink the different drinks, ask a questionnaire, and test their blood pressure. They found that the sodium-enriched coconut water did the best overall (hydration and physical performance), coconut drinks were similar to sports drinks but neither were significant. This is important because athletes who are looking for something to help them with their performance

and recovery period while participating in athletic activities will be able to have this as an option when looking to buy drinks.

Overall, the research says that carbohydrate-electrolyte drinks improve athletic ability in both aerobic capacity and anaerobic capacity and caffeine might be one of the reasons why (5, 7, 8). This study contributes to our understanding of this effect by using less experienced high school athletes in order to see if these results will still apply to them. We will have eight male high school athletes performing the RAST test (sprint test) with a placebo (Crystal Lite), a sports drink (Gatorade), and an energy drink (Monster). The RAST test measured the average power and peak capacity of the athletes (6). We hypothesized that both the sports drink and the energy drink would have a positive effect on the average power and peak performance during the sprinting test. Second, we think for the pushup test the energy drink would outperform the sports drink and placebo due to its caffeine content.

Materials and Methods

A total of 8 high school students from The Neighborhood Academy participated in the study. All participants from the study were African American, composed of males from grades 11 and 12 and between the ages of 16-18. All students in the study were athletes for some sport whether it be Track, Basketball, Wrestling, or Football.

The participants were given a brief introduction to what they would be doing in the study alongside a permission slip, to give them the basic knowledge of what they would need to do. The permission slip consisted of what the study was on and informed them they might be consuming caffeine or other sports drinks.

For the drinks, we selected a Crystal Lite drink packet that was pink lemonade flavored, red Gatorade, and original Monster. The energy drink (Monster) is made up of caffeine and carbohydrates, the sports drink (Gatorade) is made up of electrolytes and carbohydrates, and Crystal Lite is used as a placebo to hide the fact that it does nothing to improve their results. The caffeine, electrolytes, and carbohydrates for all three drinks are described above in Table 1.

Ingredients	Monster	Gatorade	Crystal Lite
Carbohydrate	29g	23.976g	0g
Electrolyte	Sodium 185mg	326.34mg-sodium, 233.1mg-potassium, 692.64mg-chloride, 69.93mg-magnesium 79.92mg-calcium	0g
Caffeine	80mg	0	0mg

Table 1. Electrolyte and carbohydrate content of drinks.

First, we recruited the athletes and gave them the permission slips then after they gave back the signed permission slips (with parent signature if under 18) we could get things ready for the experiment. For the first round of drinks, we chose to mix up the order of the drinks to the participants. We would give the participants the drink and have them drink it, then after 15 minutes, we would bring them to the marked 35-meter sprint track either in an indoor soccer field or empty hallway. We had them warm up by doing pushups for 1 minute, then sprinting 6 times with 10-second breaks. Within the 6 sprints, they were timed and told they needed to sprint as fast as possible. We would do this with 3 participants per day for 3 weeks so that the participants would have a rest period of at least three days. After we finished with the participants' sprint, we calculated all of the numbers needed to determine if my research question was correct or not through the RAST test. We needed the times of each 6 sprints, we needed the participant's body weight, and then we would calculate the participant's peak power output (PPO) for each 6 sprints by taking the body mass times the distance squared, then dividing by their sprint time cubed. We also then made an average from that. Then we need to find the fatigue index (FI), by taking the maximum PPO minus the minimum PPO divided by the total time for all 6 sprints. After we got that we needed to find the relative peak power (RPP) by taking the maximum PPO divided by their body weight, and lastly we would need to get the anaerobic capacity (AC) which is the sum of the 6 sprint PPO's.

Differences in performance were analyzed using a one-way ANOVA test for correlated samples. Individual differences were found using a Tukey post-hoc test. The abbreviation M is the mean, and SD is the standard deviation. All tests were calculated using vassarstats.net with a 0.05 significant threshold.

Results

In this experiment, we tested if an energy drink, sports drink, or placebo would affect the sprint performance or amount of pushups the athletes could perform. We had all 8 participants perform push-ups for 1 minute after 15 minutes of consuming the drink, then sprint 6 times for each of 3 different drink trials. We expected that the energy drink and sports drink would affect the athlete's sprint time and amount of pushups, but we thought the energy drink would have the more prominent difference in the athlete's sprint times and amount of pushups.

First, we analyzed the average sprint time for the three different drinks. After the athletes consumed the drink and waited 15 minutes, they performed the RAST test, which consisted of six sprints. A one-way ANOVA for correlated samples found no differences in sprint time across the three drinks ($F(2,14) = 0.9$, $p= 0.43$). While the Monster energy group ran slightly slower ($M=5.0039$, $SD= 0.5428$) than the Gatorade ($M= 4.8162$, $SD= 0.1632$) or Control ($M=4.8845$, $SD=0.3162$), this was not significant.

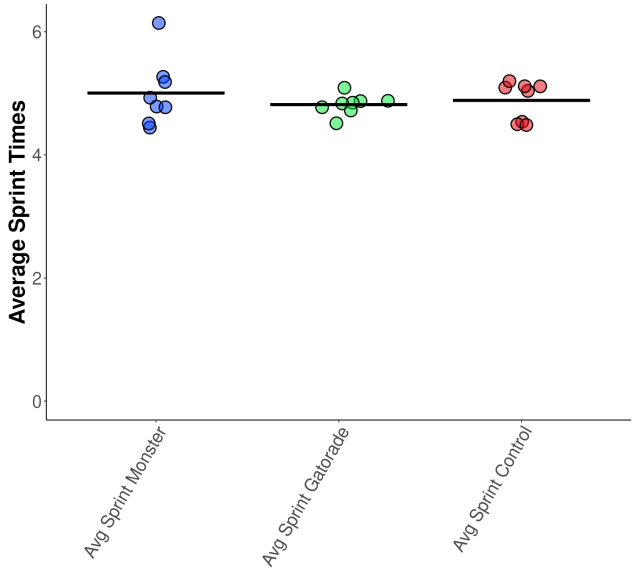

Figure 1. Average athletes sprint times compared to the three different drink trials. *Scatterplot showing the mean sprint time, for each of the three drink trials: Monster, Gatorade, and Control (n=8). Average athlete sprint time is found by taking the 6 sprints for each of the three drink trials, then adding them together and dividing by the number of sprints. One-way ANOVA correlated samples $p>0.05$.*

Then we took the sprint times and the distance the athletes ran and their body mass to find the athlete's Average Peak Power Output (PPO) was measured to figure out the highest average amount of power (measured in Watts) they were putting out for the 6 sprints for each of the three drink trials. A one-way ANOVA for correlated samples found no difference in PPOs across the three drinks ($F(2,14)=1.02$, $p=.39$). While the Gatorade group's PPO was slightly higher ($M=1841.8475$, $SD=3286.2831$) than the Monster ($M=1647.4249$, $SD=316.1983$) or Control ($M=1719.1334$, $SD=347.2867$), this was not significant.

The athletes are bound to get tired after sprinting 6 times repeatedly so we found their Fatigue Index (FI) was used to measure when and how much the athlete's performance starts to decline (when they start getting tired), where the lowest number indicates they don't get fatigued as easily. A one-way ANOVA for correlated samples found no difference in FI's across the three drink trials (F(2,24)=.5, p=.62). While Gatorade had a higher FI level (M= 26.172, SD=12.7913) than the monster (M=23.1769, SD=18.4393) or Control (M=19.9714, SD=10.3822), this was not significant.

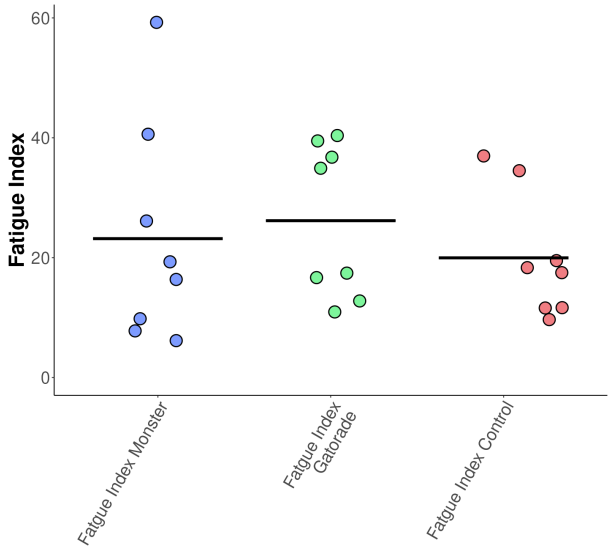

Figure 2. Fatigue Index between the athletes during the three trials. *Scatterplot showing the mean fatigue index between the three drinks and how it affected the athletes differently, (n=8). The fatigue index is to show how much the athletes get tired after/during each rep of the sprints. One-way ANOVA for correlated samples, p>0.05.*

The athletes being different sizes and weights being different make it hard to compare, so they use their weight and PPOs to get their Relative Peak Power (RPP) is used to compare the athletes in a fairer circumstance since they are taking their body mass and peak power. A one-way ANOVA for correlated samples found no difference in RPPs across the three drink trials (F(2,14)=.09, p=.91). While Control had a lower RPP level (M=12.6514, SD=1.6459) than the Monster (M=12.8404, SD=1.7331) or Gatorade (M=12.8729, SD=1.2366), this was not significant.

From all these results we wanted to find the Anaerobic Capacity (AC) which is to show the total energy output the athletes produce when performing the sprints. A one-way ANOVA for correlated samples found no difference in AC across the three drink trials (F(2,14)=.11, p=.90). While Monster had a lower level (M=9925.0499, SD=1841.4321) than the Gatorade (M=10130.0465, SD=1819.4616) or the Control (M=10314.8003, SD=2083.7205), this is not significant.

To find out the amount of weight each person used for their pushups we had to take their body weight and the amount of pushups and was able to get the total weight for each athlete. A one-way ANOVA correlated sample found no difference in total weight for push-ups across the three drink trials($F(2,14)=.57$, $p=.58$). While Monster had a higher level ($M=4960.5$, $SD=1346.4508$) than the Gatorade ($M=4879.25$, $SD=1584.3419$) or the Control ($M=4811.5$, $SD=1469.8791$), this is not significant.

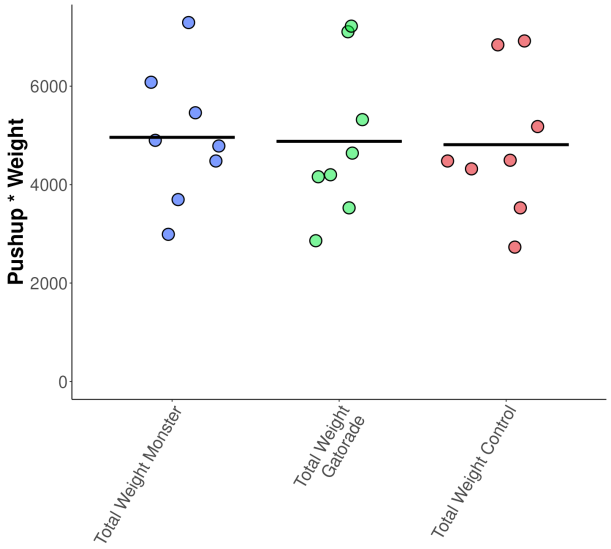

Figure 3. Total weight athletes pushed while performing push-ups during three drink trials. *Scatterplot showing the mean weight being pushed between the three drink trials and how different drinks affect the athletes (n=8). Total weight is found by taking the athletes' weight and the amount of pushups they did for each of the 3 trials multiplied. One-way ANOVA for correlated sample, $p>0.05$.*

To summarize all of our findings we found that there were no significant changes between the 3 drinks. As well there was no direct pattern with the different tests or drinks, causing our results to be insignificant.

Discussion

In this study, we determined sports drinks and energy drinks do not affect high school athletes' performances in short sprints and pushup exercises. Our first hypothesis was that both sports drinks and energy drinks would improve the athletes' sprint performance. This was not supported because throughout the experiment neither of the three drinks caused a significant change in their sprint performance **(Figure 1).** Our second hypothesis was that energy drinks would improve pushup performance in athletes, due to the caffeine content. This was not supported because in the results the pushup performance was not consistent throughout any of the three drinks **(Figure 3).**

Our results were consistent with other studies by Qazi, et al. Qazi found that there were no significant changes in the anaerobic power test between the sports drink and the ketone salt

drink mix. Our study found that between the three drinks, there were no significant differences or consistent changes throughout the RAST anaerobic power test. The fact that we both used different anaerobic power tests and were testing different drinks and found nothing significant, means that in both studies the drinks were not an important factor in our results. For these types of short exercises with non-elite athletes, sports drinks or energy drinks do not seem to change the outcome.

In contrast to McDaniel's study, we found that our athletes after consuming Monster had 4% less produced power, while McDaniel found that their skiers after consuming an energy drink had 7.3% more produced power (8). Not only is there a difference between the two percentages between our studies but the fact the energy drink didn't work for our study and worked for McDaniels shows it may not be because of our athletes or the drink, but perhaps differences in the type of exercise might explain the lack of the effect for the caffeine.

Similarly to Alamadari, et al. who found that the sports drink and placebo had no change with no improvements when performing the RAST test, we found that all three of our drinks had no change with no significant improvements with the pushups or the RAST test (6). The lack of effect for the push-ups could be because the participants are younger and less experienced, so they can't perform at a level where the drinks are helpful. Also, the athletes doing the pushups for 1 minute might have not been enough to test, instead doing pushups for longer might have a more measurable effect. Therefore for an amateur athlete, using these drinks for exercises like pushups might not be useful.

Our study had multiple limitations. Our first limitation was the amount of time the students were able to give to be able to be in my experiment since they are still high school students and we were doing this test during the school day. These limitations led to not being able to use certain people because of tests or assignments their teachers already had planned, as well as experimenting in the hallway led to people getting distracted by the other students/teachers. Our suggestion for other researchers is to make sure you have a large opening of time to be able to perform your experiment so that you would be able to do the experiment without any distractions or complications taking up the time you need. Another limitation was that some of the participants wouldn't be there on certain days we needed them to be and caused my experiment to be pushed back. Our suggestion would be to try to schedule the participants on a day and time that they are available for the whole duration of the experiment.

According to our research, sports, and energy drinks do not play a big role in affecting high school male athletes' sprint times, pushup performance, power capacity, fatigue index, or any other findings from our experiment. However, the length of the test itself and the distance were most likely a factor in this experiment. Athletes, especially high school students, should save their money on sports and energy drinks because from our study they didn't have a significant effect on the athletes when performing anaerobic tasks.

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