Practical study on electrolyte concentration in Sport Drinks impact the logarithmic increase of heartrate over a 4-minute exercise period

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Introduction/Aim/Literature Review

Sport Drinks contain electrically charged ions known as ions. Clark (2010) states that these ions are lost when exercise is performed, through our sweat, and therefore need to be replenished when exercise is performed. According to Cleveland Clinic (2020) if these electrolytes aren't replenished correctly, symptoms such as confusion, nausea, irregular heartrate, headaches, and breathing difficulties may occur. A research experiment will be conducted in order to determine the short time impacts of the logarithmic curve of heartrate for different electrolyte concentrations (different sport drinks). These different sport drinks will be tested to determine which drink most effectively replenishes the electrolytes in your body during exercise, and to test the relationship between drink electrolyte concentration, and the logarithmic curve of heartrate. A common misconception amongst people, is that more electrolytes in a sport drink will provide more effective electrolyte replenishment during exercise, however my hypothesis is that this relationship will depend more upon the ratios between the electrolytes that the drink provides, and not necessarily the total electrolyte concentration. The null hypothesis will be that there is a direct relationship between electrolyte concentration and the change in logarithmic curve of heartrate.

Methodology

In order to test the alternate and null hypothesis, a practical investigation was planned and carried out. 2 participants of similar fitness were gathered to perform 4 trials of 4 different drinks over the period of three weeks.

First trial was a control, where participants used treadmills, and performed exercises on controlled levels of altitude. Before they begin on the treadmills, heart rate was measured using two different pulseoximters, to test baseline heartrate, before any exercise is completed. BPM data was taken every 30 seconds, with values recorded from both pulseoximeters (one on each hand) to develop a trend in the relationship. After 4 minutes, the participants exited the treadmill for a 15-minute rest, where they will consume a controlled amount of Springwater (150mL) and test their BPM using the same controlled pulseoximeters, at the beginning of the 15 minutes. Their BPM was tested throughout the 15-minute break.

Springwater will be utilised for the control, as there are trace amounts of electrolytes present in a standard Springwater bottle, however, will still act to hydrate the participants as they exercise. They then entered the treadmill again, repeating the 4-minute exercise, 15-minute rest, their heartrate measured at 30 second intervals during the exercise.

3 more trials of this repeated were completed for water, and several hours should take place between these trials, to ensure that there are minimal electrolytes from the previous trial impacting the present data.

Once 4 trials were completed with Springwater, another 4 trials were completed, with a different sport drink. The methodology for this data collection was identical to the Springwater, except the participants consumed a controlled amount of 150mL Prime Hydrate. All variables apart from the independent variable (sport drink type) remained controlled. 4 different trials will be repeated using the following Sport drinks: Gatorade No Sugar, and Immunity Boost, to measure the differences in the participants BPM and allocate that to the different nutritional values of each sport/energy drink. Each sport drink amount will remain controlled, at 150mL per exercise rest period.

According to MedlinePlus (2023), electrolytes act to balance, and maintain the rhythm of your heart. Theoretically, this should mean that an imbalance, or deprivation of electrolytes should have an impact on heartrate. To compare if this effect of electrolytes is significant in each drink, a trial will be completed without any electrolyte consumption. After electrolytes are absorbed by body of participant, a second trial will be completed, so that the logarithmic heartrate scale can be compared for each value.

PRIME HYDRATE
Electrolyte Concentration :
1.668mg/mL

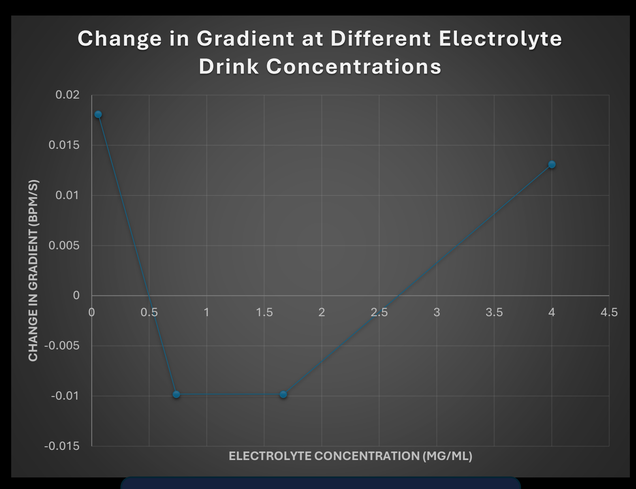
AUSTRALIAN SPRINGWATER
Electrolyte Concentration :
0.058mg/mL

GATORADE NO SUGAR
Electrolyte Concentration :
0.735mg/mL

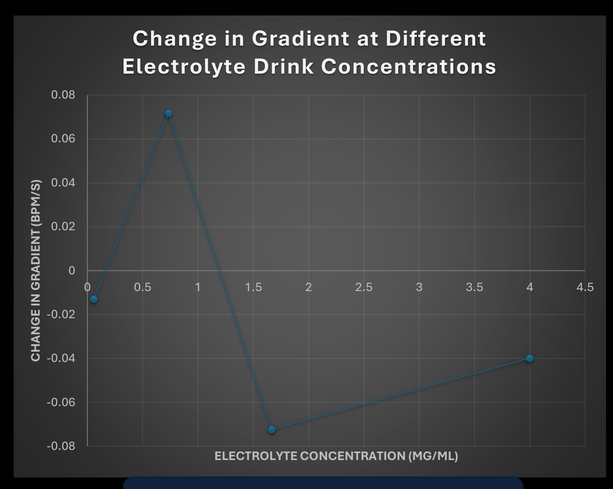
IMMUNITY SUPERBOOST
Electrolyte Concentration :
4.000mg/mL

Results

The gradient of the trendline for the before and after logarithmic curve of heartrate over the 4-minute period was calculated. The change in gradient was then calculated for each drink, and the respective electrolyte concentration for that drink was plotted with the gradient change to determine the presence or absence of a relationship.



PARTICIPANT 1 DATA



PARTICIPANT 2 DATA

Conclusion

A correlation statistical analysis was conducted for each participant to determine whether a statistically significant relationship between the variables was present. A p value of greater than 0.05 was calculated for both participants, which means that we can accept our hypothesis, and conclude that there is no short-term relationship between the electrolyte concentration and the change in the logarithmic curve of heartrate.

Analysis

For both participants, it can be stated that Gatorade No Sugar provided the greatest negative gradient magnitude. This means that out of each drink, Gatorade had the greatest decreasing effect of heartrate. This can be related to the ratios of electrolytes, rather than the total electrolyte concentration. A study performed by Tang et al (2016) states that the electrolyte ratio lost in sweat for Sodium : Potassium : Magnesium : Calcium, is 1.000 : 0.1488 : 0.004650 : 0.04800 respectively The electrolyte ratio of Sodium : Potassium in Gatorade No Sugar is 1.000 : 0.4412, respectively. Prime Hydrate's ratio between Sodium : Potassium : Magnesium are 1.00 : 70.0 : 12.4, and Immunity Super Boost is 1.000 : 4.084 : 0.08530. When the electrolyte concentration ratios of Prime Hydrate and Immunity Super Boost are compared to the theoretical electrolyte replenishment proposed by Tang's study, it can be seen that Immunity Super Boost and Prime Hydrate have an excess in Potassium and Magnesium, however, do not contain enough Sodium to support this excess. Gatorade No Sugar provides electrolyte ratios closest to the theoretical and decreases the logarithmic curve of heartrate the most during the short period of exercise for both participants. Since there is no correlative relationship between electrolyte concentration and effects on heartrate, this could mean that the electrolyte ratios are more important during exercise than the actual total electrolyte concentration supplied in the drink.

This means that Sport Drinks that state that they have a high number of electrolytes may be misleading their audience into thinking that this high electrolyte concentration will directly impact their performance during exercise, whereas it is more dependent on the ratios between these electrolytes, and not the actual electrolyte total. The public should be more aware, and careful, when purchasing sport drinks that claim to have a 'high electrolyte concentration' to avoid potential health determents that may occur due to an excess of specific electrolytes.