# Metabolic Responses to Supramaximal Exercise Lab Report

Name

Institution

## Title

The title of the report was; “Metabolic Responses to Supramaximal Exercise”

## Introduction/Purpose

The experiment aimed at measuring the amount VO2 produced during supramaxial exercises and the corresponding O2 required to undertake such kind of activities. It sought to establish the concise relationship between the amount of VO2 and VCO2 produced in the process. Additionally, the report seeks to establish the correlation between different parameters such as weight, height and gender and the power output during a supramaximal exercise. The experiment also aimed at measuring the Energy Expenditures (EE) and Metabolic Rates (MR) for both males and females. The report additionally seeks to answers questions such as “does the Surface Area to Body Ratio affect the EE and MR?” “What is the relationship between oxygen consumption and the power output?” We assumed that the surface area to body ratio had an impact to the energy requirements of the body due to the increased amount of oxygen required and that the rise in consumption rates led to a higher power output. We also formulated a hypothesis that the female gender had a higher VO2max compared to the male counterpart. It was found that indeed surface area to body ratio had a relationship with EE and MR in that S.A to body ratio = EE/MR (Plowman, & Smith, 2008). In addition, it was discovered that the higher the energy consumption rate the higher the power output and that the females had a higher VO2max compared to the males.

## Materials

The apparatus that were used during the practical included; 10 Males with variable height and weight, 10 females with variable height and weight, a Cycle ergometer, a Stethoscope, one Meter rule and a Weighing Balance.

## Methods/Procedure

The following is a description of how the experiement was conducted. The weight of the males was measured using a weighing balance and the result recorded down in a table. The height of the male participates was then measured using a meter rule and noted down in another column. The ages of the various male participants was then recorded in another column corresponding to their heights and weights. Using the Cycle ergometer, a Wingate test was conducted on the males that provided the participants’ heart rate, RPE and blood lactate and recorded in separate columns. The six males were then asked to run around laboratory and the Wingate test was conducted again and data was recorded after the activity after 10 seconds. The test was repeat after 30seconds of their activities and results noted down. The same procedure was repeated for the remnant six female participants.

## Data

After the procedures were perfomed, the following data was recorded.

10 seconds Wingate

| | | | | | | | | Heart rate | | | | | RPE | | Blood Lactate | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Subject** | **Sex** | **Age** | **Height** | **Body Weigh** | **Average** | **% Aerobi** | **% Anaerobi** | **Pre** | **Post** | **30s** | **60s** | **90s** | **Pre** | **Post** | **Pre** | **60s** |

| | | | | t (kg) | power (W) | c | c | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Male | 22 | 177 | 65 | 788 | 19.7 | 80.3 | 100 | 165 | 150 | 137 | 126 | 6 | 14 | 3.6 | 6.8 |
| 2 | Female | 23 | 165 | 66 | 750 | 10.5 | 89.5 | 80 | 144 | 127 | 117 | 117 | 6 | 17 | 2.1 | 11.4 |
| 3 | Male | 22 | 181 | 70 | 755 | 13.6 | 86.4 | 70 | 155 | 130 | 120 | 111 | 7 | 15 | 3.0 | 9.6 |
| 4 | Male | 22 | 181 | 90 | 800 | 18.2 | 81.8 | 82 | 160 | 140 | 125 | 94 | 6 | 14 | 2.4 | 5.7 |
| 5 | Female | 21 | 163 | 55 | 639 | 12.1 | 87.9 | 85 | 150 | 122 | 111 | 100 | 6 | 13 | 3.6 | 8.7 |
| 6 | Male | 23 | 181 | 82 | 782 | 13.6 | 86.4 | 83 | 163 | 132 | 124 | 115 | 6 | 17 | 3.0 | 5.7 |
| 7 | Male | 24 | 186 | 91 | 821 | 10.2 | 89.8 | 74 | 158 | 123 | 119 | 95 | 7 | 16 | 2.5 | 6.7 |
| 8 | Female | 22 | 177 | 79 | 731 | 16.4 | 83.6 | 93 | 143 | 131 | 120 | 112 | 6 | 16 | 1.9 | 4.7 |
| 9 | Female | 23 | 165 | 62 | 772 | 10.1 | 89.9 | 82 | 149 | 120 | 110 | 100 | 6 | 15 | 2.8 | 8.1 |
| 10 | Female | 25 | 173 | 70 | 782 | 12.4 | 87.6 | 77 | 157 | 129 | 121 | 94 | 6 | 14 | 3.4 | 6.1 |
| 11 | | | | | | | | | | | | | | | | |
| **Average** | | **22.7** | **174.9** | **73.0** | **762.0** | **13.7** | **86.3** | **83** | **154** | **130** | **120** | **106** | **6.2** | **15.1** | **2.8** | **7.4** |
| **SD** | | **1.2** | **8.1** | **12.0** | **50.3** | **3.4** | **3.4** | | **9** | **8** | **9** | **8** | **11** | | **0.4** | **1.4** |

30 seconds Wingate

| | | | | | | | | Heart rate | | | | | RPE | | Blood Lactate | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Subject** | **Sex** | **Age** | **Height** | **Body Weight (kg)** | **Average power (W)** | **% Aerobic** | **% Anaerobic** | **Pre** | **Post** | **30 s** | **60 s** | **90 s** | **Pre** | **Post** | **Pre** | **60s** |
| 1 | Male | 21 | 179 | 71 | 450 | 21.2 | 78.8 | 75 | 186 | 163 | 155 | 145 | 6 | 16 | 3 | 12.3 |
| 2 | Female | 23 | 163 | 55 | 255 | 19.9 | 80.1 | 73 | 147 | 135 | 127 | 116 | 6 | 19 | 1.4 | 9 |
| 3 | Male | 22 | 190 | 110 | 540 | 24.2 | 75.8 | 80 | 189 | 165 | 145 | 137 | 6 | 19 | 3 | 13.4 |
| 4 | Male | 21 | 183 | 89 | 432 | 30.4 | 69.6 | 83 | 160 | 145 | 134 | 125 | 6 | 18 | 2.1 | 16.1 |
| 5 | Female | 22 | 171 | 60 | 396 | 25.3 | 74.7 | 74 | 180 | 157 | 134 | 111 | 6 | 17 | 3.4 | 15.2 |
| 6 | Female | 22 | 163 | 52 | 299 | 26.4 | 73.6 | 93 | 197 | 165 | 154 | 147 | 6 | 18 | 2.5 | 16.7 |
| 7 | Male | 22 | 181 | 73 | 428 | 29.3 | 70.7 | 82 | 186 | 168 | 136 | 112 | 7 | 16 | 3.6 | 12.2 |
| 8 | Male | 23 | 180 | 81 | 430 | 32.7 | 67.3 | 70 | 178 | 145 | 139 | 118 | 6 | 17 | 2.4 | 8.7 |
| 9 | Female | 25 | 177 | 70 | 419 | 21.2 | 78.8 | 100 | 169 | 167 | 148 | 126 | 6 | 15 | 2.8 | 14.2 |
| 10 | Male | 23 | 187 | 92 | 479 | 18.4 | 81.6 | 85 | 198 | 167 | 138 | 118 | 6 | 20 | 2.5 | 10.2 |
| 11 | | | | | | | | | | | | | | | | |
| **Average** | | **22.4** | **177.4** | **75.3** | **412.8** | **24.9** | **75.1** | **82** | **179** | **158** | **141** | **126** | **6.1** | **17.5** | **2.67** | **12.8** |
| **SD** | | **1.2** | **9.2** | **18.1** | **82.3** | **4.8** | **4.8** | **9** | **16** | **12** | **9** | **13** | **0.3** | **1.6** | **0.6** | **2.8** |

Comparison of the VO2max of male and female

| Female VO2max | Male VO2max |
|---|---|
| 42.2 | 43.3 |

| | |
|---|---|
| 40.5 | 49.2 |
| 34.3 | 65.3 |
| 49.4 | 43.5 |
| 34.9 | 36.7 |
| 43.5 | 33.4 |
| 0.919238816 | 7.000357134 |
| 42.85 | 38.35 |

## Results/Interpretation

From the data, it is concise that the anaerobic rate is higher in the first ten seconds when compared to the percentage rate of the aerobics. It can also be seen that the heart rate of the participants increased after the supramaximal exercise. However, the heart rate began lowering after 30 seconds of the activity. The RPE and blood lactate significantly rose after the activity too. There was also corresponding relation between the body weight and height to the average power produced. However, it was determined that the average power was directly proportional to the percentage rate of the aerobics activity. Additionally, the average power of males was generally higher compared to the average power of the females.

It was also noted that the aerobics percentage had greatly multiplied after 30 seconds of activity while the anaerobic percentage had tremendously declined. The VE/VO2 and VE/VCO2 were noticed to have risen after the exercise. Nonetheless, the volumes of VO2 and VCO2 had generally increased after the exercise. The VO2 for participants with great height and weight had a quickly risen in the first 30 seconds. The average power was inversely proportional to the volume of VO2 recorded. The overall VO2max for females was higher than that of males.

## Discussion and Analysis

The rate of anaerobic was high in the first ten seconds to the limited supply of oxygen to the body. During this period, the body had used up all the available Oxygen in respiration just at the beginning of the exercise. Energy was being synthesized using anaerobic means accounting for a higher percentage of anaerobic than aerobics during the first 10 seconds. The rate at which blood was pumped to the muscles for aerobic respiration was less compared to the rate at which aerobic respiration occurred. According to Toole (2004), living organisms can respire in the absence of oxygen to produce energy through a process known as fermentation. After pyruvate has been formed through glycolysis, the product is the broken down to lactate (lactic acid) and CO2 is produced as the by-product (MacLaren & Morton, 2012). This accounts for the rise in blood lactate and VCO2 after the supramaximal exercise. Consequently, the body had to come up with a mechanism to compensate for Oxygen deficit that was being observed in the body muscles. This provides an explanation for the increased heart beat rate during the first 10 seconds of the exercise. After enough Oxygen had been pumped to the muscles, the mitochondria had enough oxygen to synthesize energy greatly required for aerobic respiration. Aerobic respiration is preferred due to its ability to produce more energy in comparison to the anaerobic type respiration (Abernethy, 2013). This accounts for the increased aerobic level in the subsequent 30 seconds of the strenuous activity. The heartbeat was also restored to its normal levels after adequate levels of Oxygen reached the body muscles. This explains the declination in the heartbeat rates during the successive 20 seconds of the exercise.

As stated in the previous section, the amount of energy produced by the anaerobic respiration is relatively low compared to aerobic respiration. Anaerobic respiration produces only 2-ATP molecules per one glucose molecule while aerobic respiration produces 4-ATP molecules with the equivalent amount of glucose (Gropper, Smith & Groff, 2009). After 10 seconds of the activity, enough oxygen had been pumped throughout the body muscles thus the demand for oxygen was reduced to normal levels. The increased level of oxygen accounts for the rise in aerobic percentage rates at the completion of the exercise. This accounts for the escalation of VO2 levels at the end of the exercise. The RPE increased due to the limited supply of oxygen as it was pumped to the muscles for respiration purpose to provide the body with enough energy for flight. Supramaximal exercises require more oxygen capacities in order to synthesize optimal energy levels required for the strenuous exercise (Alpers, 2008).

The weight and height was directly proportional to the level of energy produced to the amount of energy requirements. Students that had great parameters produced more energy due to the increased level of power that was needed for the body to take off. Additionally, these students had a greater number of cells implying that they had enormous number of mitochondria that produced more energy after respiration took place (Alpers, 2008). The males produced great energy due to their prevalent and strong muscles compared to the females. As Jenkins (2015) asserts, males have strong muscles that are responsible for producing much energy that is responsible for muscle movement.

The ratios VE/VO2 and VE/VO2 increased due to the increase in the amount of energy that was produced after respiration. Anaerobic respiration produces a net amount of 2 ATP molecules after the glycolysis stages while the aerobic respiration produced two extra ATP molecules in the successive Krebs cycle (Beckett, 2016). The VO2 for participants with great height and weight increased tremendously in the first 10 seconds due to the small Surface Area to Body Ratio. Large body sizes require more oxygen and more energy compared to small bodies Brown, Miller & Eason, 2006). Moreover, the amount of energy of VO2max was proportional to the average power produced due the presence of more Oxygen molecules. The VO2max for females was higher than that of males because the females used less energy in the exercise (Connes, Hue & Perrey, 2010).

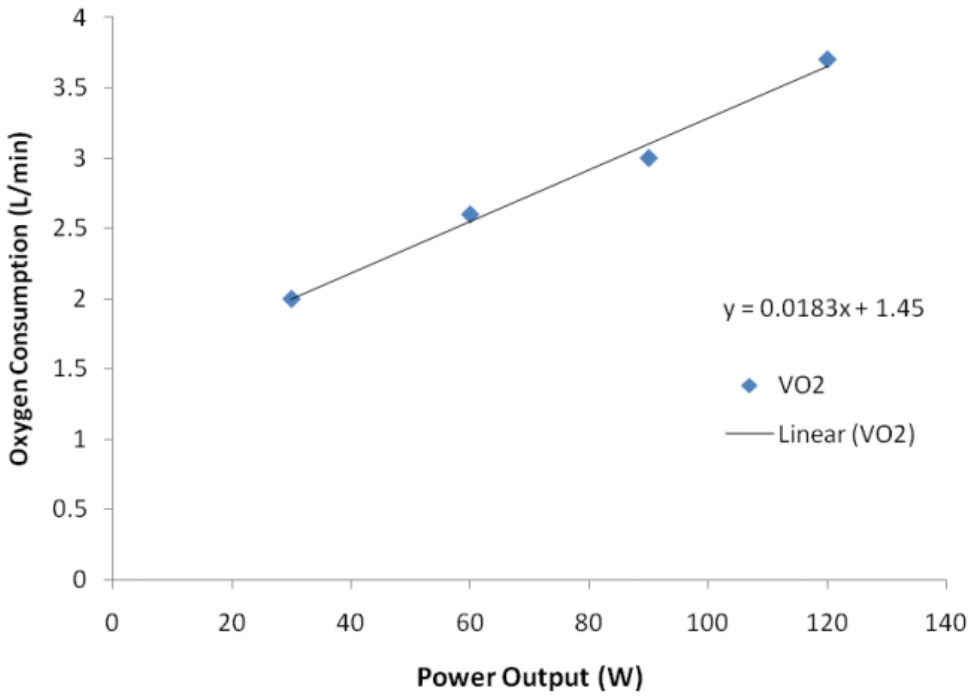
## Conclusion

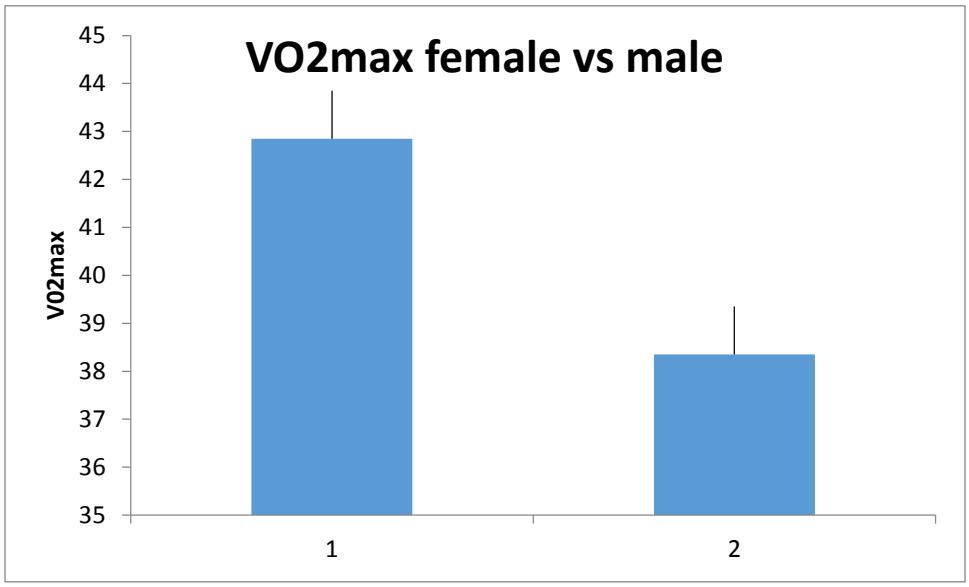
In conclusion, the amount of oxygen determined the amount of energy/power produced. During the beginning of activity, the amount of oxygen was lower compared to the required amount resulting to oxygen debt. This concludes that the rate of anaerobic is high at the start of supramaximal exercises and lowers as the activity progresses. In addition, the amount of energy produced during strenuous exercises is higher in males than in female due to high metabolism rates. Furthermore, organisms with small surface area to body ratios produce high levels of energy than creature with relatively small bodies. The power produced throughout a supramaximal exercise increases with the VO2max levels. The VO2max is higher in females than in males.

Figure and Graphs

The Energy Expenditure (EE)
EE = VO2 (L/min) x kcal equivalent (based on RER or RQ in table 8.1)
EE = 0.607 x 0.94
= 0.57058 kcal/min
2. Metabolic rate (MR)
MR = EE / (Body surface area)
= EE / (0.20247 x height0.725 x weight0.425)
= 0.57058 / 0.0638
= 8.9433 kcal/m2
/min

Below is a graph of the power output and VO2 relationship graph
Linear Equation (y=mx + c)






A graph comparing the VO2max for female against male

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