



*CALGARY YOUTH SCIENCE FAIR PROJECT*

*THE EFFECT OF EXERCISE ON HEART  
RATE*

*BY*

*SHYLOH IKHAJIAGBE*

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## 1.0 Introduction

Have you ever wondered how fast your heart is beating after a long run? Or how many times your heart beats when you have done some exercise? Well, did you know, the normal resting heart rate for adults is usually 60-100 BPM and as kids reach the age of 12 years, their heart is close to that of an adult and it is between 55-85 BPM. That's pretty interesting! <sup>1</sup>



**Figure 1: Heart Rate Changes with Exercise <sup>2</sup>**

Staying healthy is not all about what you eat or drink, keeping fit by working out and exercising is also key to a healthy living. The kind of exercise that is good for the heart must elevate one's heart rate.

“The American Heart Association (AHA) recommends doing exercises that increases a person's heart rate to 50-85 percent of their maximum heart rate. This range is known as the target heart rate zone. <sup>3</sup>

In this science project, I will be measuring how fast the heart beats when doing various activities.

## **2.0 Scientific Questions**

I chose this topic for my science fair project because the heart is a very fascinating organ! It has always been amazing to see how the heart helps pump blood all around your body. I've always been amazed by it. This is one of the reasons I really wanted to do this for my science fair project. Another reason is that people have become more aware of how important exercising one's body is especially during the Covid-19 pandemic where a healthy and strong body can help build a strong immune system.

In light of this, my scientific questions are:

1. What effect does exercise have on heart rate?
2. Which factors influence the heart rate? e.g., age, activity levels, body position etc.

This will be an interesting experiment! Does your heart pump faster or slower when you walk compared to standing in one place? I am very excited to start this project and I think this will be an amazing topic to touch upon.

## **3.0 Variables**

### **3.1 Manipulated Variables**

- I. My manipulated variable is using different people to complete the same task.
- II. Using Adults and Kids with varying age groups to complete the same task

### **3.2 Responding Variable**

- I. For my responding variable it will be getting different but similar answers from each person.

### 3.3 Constant Variable:

- I. Now for the constant variable. That would be doing the same exercise for the same amount of time for all people participating in the study.

### 4.0 Research

The heart is a very essential organ in the body. The heart affects everything in the body.

It pumps blood around the whole body. How does it do all of this? The heart is separated into two parts. The right side of your heart has the right ventricle and the right atrium. The right side of the heart is where it takes the blood that doesn't have as much oxygen then pumps it into your lungs. Which then sucks up the oxygen and disposes of the carbon dioxide.

The left side of the heart takes the blood from the lungs and transfers it throughout the whole body.

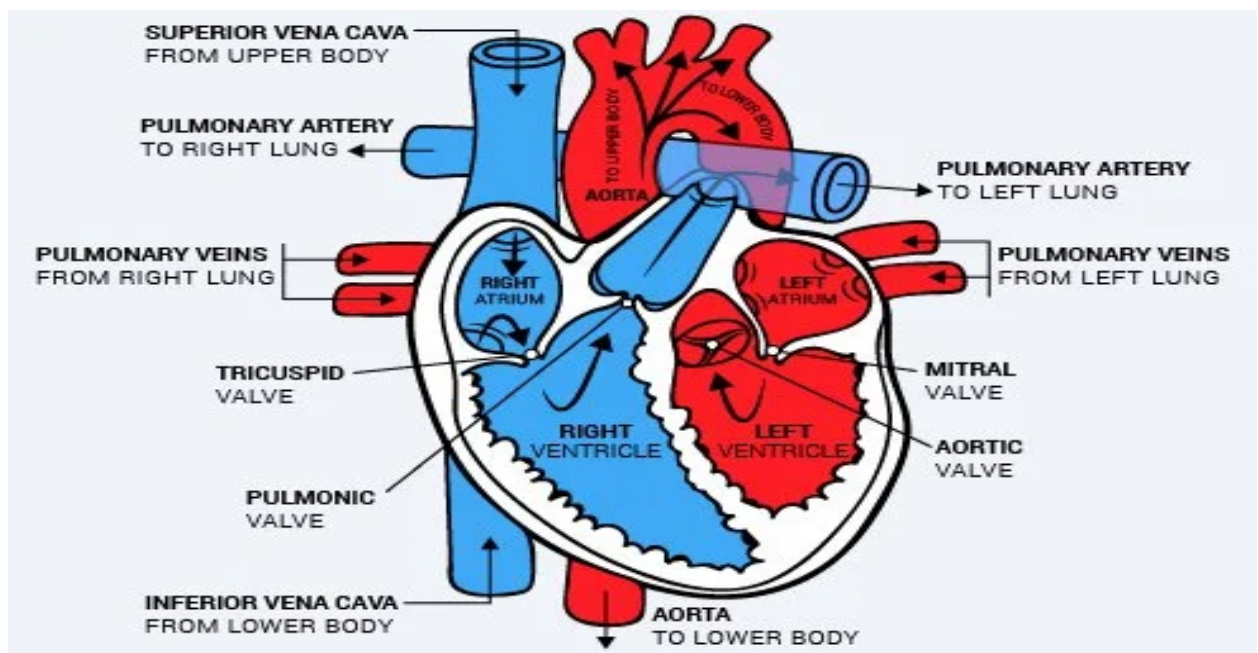


Figure 2: Parts of the Heart <sup>4</sup>

The second part of my topic is exercise. As studies have shown, it is very important to stay healthy especially with the current pandemic, where being healthy affects recovery rates of people who test positive to Covid - 19. Exercise is one of the ways to keep physically and mentally fit and healthy because it makes the heart way more efficient by stimulating it. How? This is because the stronger and more efficient the heart becomes, the more blood it will be able to pump throughout your body. This means that one beat will pump more and more blood for the body. How is exercise good for your mental health? Well, when you exercise it reduces depression as well as anxiety and boosts one's self-esteem. You will also feel more and more energized as you exercise. This is just some of the many benefits that exercise can do for your cardiovascular health and psychological health<sup>5</sup>.

So how exactly does exercise affect the heart rate? This will be the question that I will be able to answer at the end of this project.

Here are some interesting facts! An average size of a heart is actually the size of an adult's fist. Some others say that the beating noise that you hear from your heart is actually caused by the valves of the heart opening and closing. Did you know that laughing is good for your heart? It reduces stress and gives a boost to your immune system. The bottom line is that the heart is very crucial to your survival<sup>6</sup>. The more one exercises the lower the resting heart rate (RHR)

#### **4.1 Benefits of Exercise**

There are many benefits to exercising, not doing anything about one's health leads to major risk factor such as high blood pressure, abnormal values for blood lipids, obesity, diabetes to mention a few. Scientific research has shown that reducing these risk factors decreases the chance of having a heart attack or any other cardiovascular disease such as stroke.

In order to ensure that one does not suffer from such, exercising and eating healthy is key. It is also very important to know one's limit when exercising to make sure that you do not overexert yourself. The following are some benefits of exercising:

- I. Increase in exercise tolerance
- II. Reduction in weight
- III. Reduction in blood pressure
- IV. Reduction in Cholesterol
- V. Increase in insulin sensitivity<sup>7</sup>

## **5.0 Hypothesis**

**Hypothesis 1:** Running will increase the heart rate the most out of all the other activities.

**Hypothesis 2:** An adult's heart rate while running is higher than a kid's heart rate while performing the same exercise.

**Hypothesis 3:** As the body position changes, so does the heart rate.

## **6.0 Experimental Design**

### **6.1 Materials Required**

- Fitness Watch 2x
- Timer
- Pencil
- Data entry paper
- 20 Test Subjects

## 6.2 Procedure

In testing out my hypothesis, I will be using a total of 20 test subjects. The test subjects will be required to carry out all the activities and three readings will be taken to ensure accuracy for each of the activities and an average will be calculated. The following are the steps that will be taken:

1. The person wears the watch on their wrist.
2. After wearing the watch, I will start the timer and they will do the activity.
3. The first activity which is sitting, will require the subject to sit for two minutes and three heart rate readings taken at the end of 2 minutes.
4. The second activity which is standing, will require the subject to stand for two minutes and three heart rate readings taken at the end of 2 minutes.
5. The third activity which is walking, will require the subject to walk for two minutes and three heart rate readings taken at the end of 2 minutes.
6. The fourth activity which is jogging, will require the subject to jog for two minutes and three heart rate readings taken at the end of 2 minutes.
7. The final activity, which is running, will require the subject to run for two minutes and three heart rate readings taken at the end of 2 minutes.
8. A total of 20 people will be tested for all activities (10 Adults and 10 Children)

In order to make sure that the constant variables (which are the activities to be performed and the duration,) are the same, I will ensure that each subject is made to complete the same activities and use a timer to calculate the duration which is two minutes.

The test subjects will be changed in order to form a basis for comparing the data that will be collected and data recorded for the same activities, but with varying heart rate results.



### 6.3 Data Collection

The following data were collected from the 20 subjects for the analysis. The data has been divided according to the following criteria to show the various activities and their corresponding heart rates:

Table 1: Heart Rate with activities for considered Age Group

TEST SUBJECTS		1	2	3	4	5	6	7	17	18	19	8	9	10	11	12	13	14	15	16	20
GENDER	NO. OF HEART RATE READING	MALE	FEMALE	FEMALE	MALE	FEMALE	FEMALE	FEMALE	MALE	MALE	MALE	MALE	FEMALE	FEMALE	FEMALE	FEMALE	MALE	MALE	MALE	MALE	FEMALE
		AGE RANGE	11-13	14-16	14-16	8-10	11-13	11-13	11-13	8-10	8-10	14-16	41-50	41-50	41-50	30-40	41-50	30-40	41-50	30-40	30-40
Sitting	1st Reading	71	74	72	81	88	79	93	83	73	75	73	82	72	86	68	72	81	70	69	83
	2nd Reading	72	72	74	82	89	76	90	84	74	76	69	80	69	80	65	74	78	68	72	82
	3rd Reading	71	71	73	83	86	78	92	82	75	73	62	79	68	83	66	69	79	66	75	81
	Average	71.33	72.33	73.00	82.00	87.67	77.67	91.67	83.00	74.00	74.67	68.00	80.33	69.67	83.00	66.33	71.67	79.33	68.00	72.00	82.00
Standing	1st Reading	68	69	81	90	108	98	92	93	78	85	75	96	77	95	81	75	96	90	72	85
	2nd Reading	72	66	84	91	92	100	93	91	76	87	78	98	84	90	83	76	97	89	76	84
	3rd Reading	70	68	82	90	93	101	95	90	75	84	76	97	88	88	82	79	95	87	78	87
	Average	70.00	67.67	82.33	90.33	97.67	99.67	93.33	91.33	76.33	85.33	76.33	97.00	83.00	91.00	82.00	76.67	96.00	88.67	75.33	85.33
Walking	1st Reading	85	90	97	95	112	122	122	96	90	95	84	110	95	105	107	89	103	105	89	90
	2nd Reading	83	91	96	97	113	121	120	97	87	93	89	115	96	106	109	90	101	110	91	95
	3rd Reading	82	89	98	96	115	123	113	94	85	96	90	114	97	103	107	86	99	108	95	92
	Average	83.33	90.00	97.00	96.00	113.33	122.00	118.33	95.67	87.33	94.67	87.67	113.00	96.00	104.67	107.67	88.33	101.00	107.67	91.67	92.33
Jogging	1st Reading	145	128	126	113	120	155	135	110	108	124	154	131	125	135	146	131	126	135	110	118
	2nd Reading	143	129	124	111	119	156	136	115	112	123	150	133	126	138	145	128	127	137	113	119
	3rd Reading	140	130	122	110	117	157	134	114	116	122	155	130	124	132	147	127	128	135	115	121
	Average	142.67	129.00	124.00	111.33	118.67	156.00	135.00	113.00	112.00	123.00	153.00	131.33	125.00	135.00	146.00	128.67	127.00	135.67	112.67	119.33
Running	1st Reading	183	148	155	144	174	195	164	158	136	167	174	154	160	148	160	162	157	152	144	162
	2nd Reading	173	146	153	141	176	196	164	159	143	165	166	146	159	142	163	157	159	155	147	158
	3rd Reading	172	145	152	145	169	192	167	160	147	166	160	148	155	140	154	159	155	157	149	154
	Average	176.00	146.33	153.33	143.33	173.00	194.33	165.00	159.00	142.00	166.00	166.67	149.33	158.00	143.33	159.00	159.33	157.00	154.67	146.67	158.00

Table 2: Heart Rate with activities for the male gender

TEST SUBJECTS	NO. OF HEART RATE READING					
GENDER		MALE (CHILDREN)			MALE (ADULT)	
AGE RANGE		8-10	11-13	14-16	30-40	41-50
Sitting	1st Reading	78	71	75	70	77
	2nd Reading	79	72	76	71	74
	3rd Reading	79	71	73	70	71
	<b>Average</b>	<b>79</b>	<b>71</b>	<b>75</b>	<b>71</b>	<b>74</b>
Standing	1st Reading	85.5	68	85	79	85.5
	2nd Reading	83.5	72	87	80	88
	3rd Reading	83	70	84	81	86
	<b>Average</b>	<b>84</b>	<b>70</b>	<b>85</b>	<b>80</b>	<b>86</b>
Walking	1st Reading	93	85	95	94	93.5
	2nd Reading	92	83	93	97	95
	3rd Reading	90	82	96	96	95
	<b>Average</b>	<b>92</b>	<b>83</b>	<b>95</b>	<b>96</b>	<b>94</b>
Jogging	1st Reading	109	145	124	125	140
	2nd Reading	114	143	123	126	139
	3rd Reading	115	140	122	126	142
	<b>Average</b>	<b>113</b>	<b>143</b>	<b>123</b>	<b>126</b>	<b>140</b>
Running	1st Reading	147	183	167	153	165.5
	2nd Reading	151	173	165	153	163
	3rd Reading	154	172	166	155	158
	<b>Average</b>	<b>151</b>	<b>176</b>	<b>166</b>	<b>154</b>	<b>162</b>

Table 3: Heart Rate with activities for the female gender

TEST SUBJECTS	NO. OF HEART RATE READING				
GENDER		FEMALE (CHILDREN)		FEMALE (ADULT)	
AGE RANGE		11-13	14-16	30-40	41-50
Sitting	1st Reading	87	73	85	74
	2nd Reading	85	73	81	71
	3rd Reading	85	72	82	71
	<b>Average</b>	<b>86</b>	<b>73</b>	<b>83</b>	<b>72</b>
Standing	1st Reading	99	75	90	85
	2nd Reading	95	75	87	88
	3rd Reading	96	75	88	89
	<b>Average</b>	<b>97</b>	<b>75</b>	<b>88</b>	<b>87</b>
Walking	1st Reading	119	94	98	104
	2nd Reading	118	94	101	107
	3rd Reading	117	94	98	106
	<b>Average</b>	<b>118</b>	<b>94</b>	<b>99</b>	<b>106</b>
Jogging	1st Reading	137	127	127	134
	2nd Reading	137	127	129	135
	3rd Reading	136	126	127	134
	<b>Average</b>	<b>137</b>	<b>127</b>	<b>127</b>	<b>134</b>
Running	1st Reading	178	152	155	158
	2nd Reading	179	150	150	156
	3rd Reading	176	149	147	152
	<b>Average</b>	<b>177</b>	<b>150</b>	<b>151</b>	<b>155</b>

Table 4: Heart Rate of Children

TEST SUBJECTS	NO. OF HEART RATE READING	CHILDREN		
GENDER				
AGE RANGE		8-10	11-13	14-16
Sitting	1st Reading	79	83	74
	2nd Reading	80	82	74
	3rd Reading	80	82	72
	<b>Average</b>	<b>80</b>	<b>82</b>	<b>73</b>
Standing	1st Reading	87	92	78
	2nd Reading	86	89	79
	3rd Reading	85	90	78
	<b>Average</b>	<b>86</b>	<b>90</b>	<b>78</b>
Walking	1st Reading	94	110	94
	2nd Reading	94	109	93
	3rd Reading	92	108	94
	<b>Average</b>	<b>93</b>	<b>109</b>	<b>94</b>
Jogging	1st Reading	110	139	126
	2nd Reading	113	139	125
	3rd Reading	113	137	125
	<b>Average</b>	<b>112</b>	<b>138</b>	<b>125</b>
Running	1st Reading	146	179	157
	2nd Reading	148	177	155
	3rd Reading	151	175	154
	<b>Average</b>	<b>148</b>	<b>177</b>	<b>155</b>

Table 5: Heart Rate of Adult vs Children

TEST SUBJECTS	NO. OF HEART RATE READING	CHILDREN			ADULT	
GENDER		8-10	11-13	14-16	30-40	41-50
AGE RANGE						
Sitting	1st Reading	79	83	74	76	75
	2nd Reading	80	82	74	75	72
	3rd Reading	80	82	72	75	71
	<b>Average</b>	<b>80</b>	<b>82</b>	<b>73</b>	<b>75</b>	<b>73</b>
Standing	1st Reading	87	92	78	83.4	85
	2nd Reading	86	89	79	83	88
	3rd Reading	85	90	78	84	88
	<b>Average</b>	<b>86</b>	<b>90</b>	<b>78</b>	<b>83</b>	<b>87</b>
Walking	1st Reading	94	110	94	96	100
	2nd Reading	94	109	93	98	102
	3rd Reading	92	108	94	97	101
	<b>Average</b>	<b>93</b>	<b>109</b>	<b>94</b>	<b>97</b>	<b>101</b>
Jogging	1st Reading	110	139	126	126	136
	2nd Reading	113	139	125	127	136
	3rd Reading	113	137	125	126	137
	<b>Average</b>	<b>112</b>	<b>138</b>	<b>125</b>	<b>126</b>	<b>136</b>
Running	1st Reading	146	179	157	153.6	161
	2nd Reading	148	177	155	152	159
	3rd Reading	151	175	154	152	154
	<b>Average</b>	<b>148</b>	<b>177</b>	<b>155</b>	<b>152</b>	<b>158</b>

## 7.0 Statistical Analysis

In this part of my project, I will talk about central tendency values, mean, median and mode of children vs adults based on the BPM data presented in table 4.

Heart rate in Sitting position

Mean:

$$73+73+75+80+82 \div 5$$

$$= 383 \div 5$$

$$= 77$$

Median: List of data from lowest to highest

73 73 75 80 82

The median is 75 because it's the middle number of the 5 data values.

Mode: The most commonly occurring number

$$= 73$$

Range: Subtraction of lowest from highest number

$$= 82 - 73$$

$$= 9$$

Standard Deviation

Data	- Mean	Value Squared
73	- 77 = -4	$-4^2 = 16$
73	- 77 = -4	$-4^2 = 16$
75	- 77 = -2	$-2^2 = 4$
80	- 77 = 3	$3^2 = 9$
82	- 77 = 5	$5^2 = 25$
Variance $= 16 + 16 + 4 + 9 + 25 \div 5$ $= 70 \div 5$ $= 14$ Standard Deviation Square root of 14 $= 3.74$		

## 8.0 Graphical Representation

### What effects does Exercise have on the heart

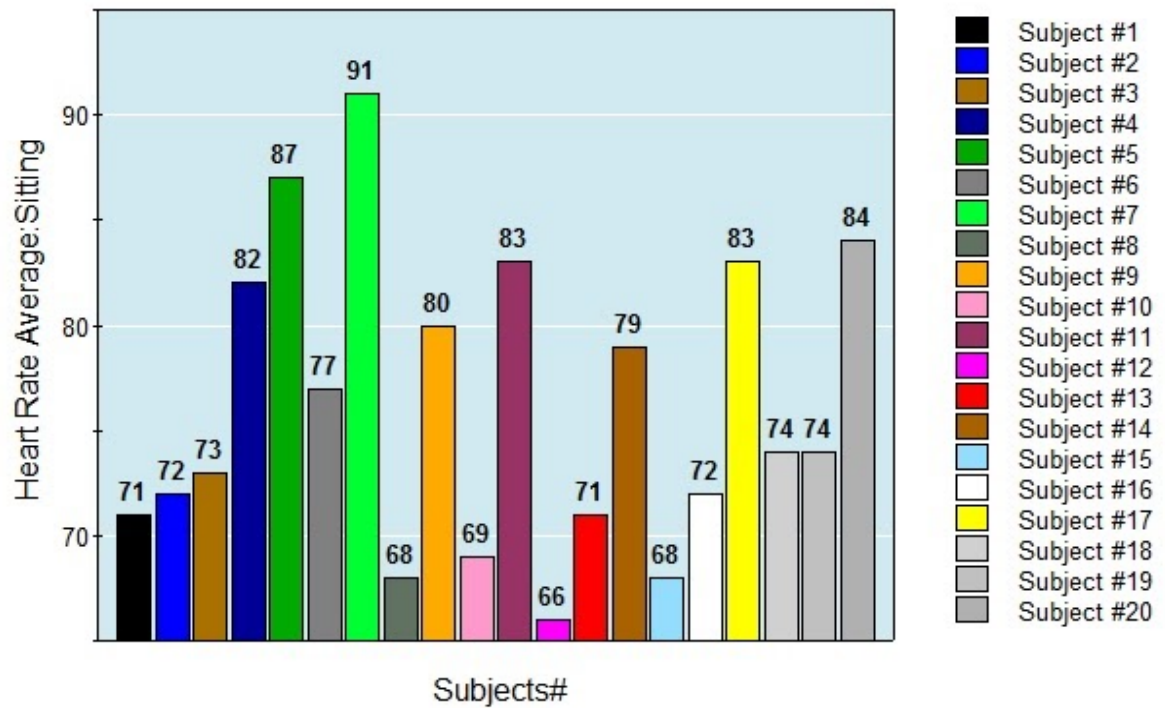


Figure 3: Showing Average Heart Rate (Sitting)

## What effects does Exercise have on the heart

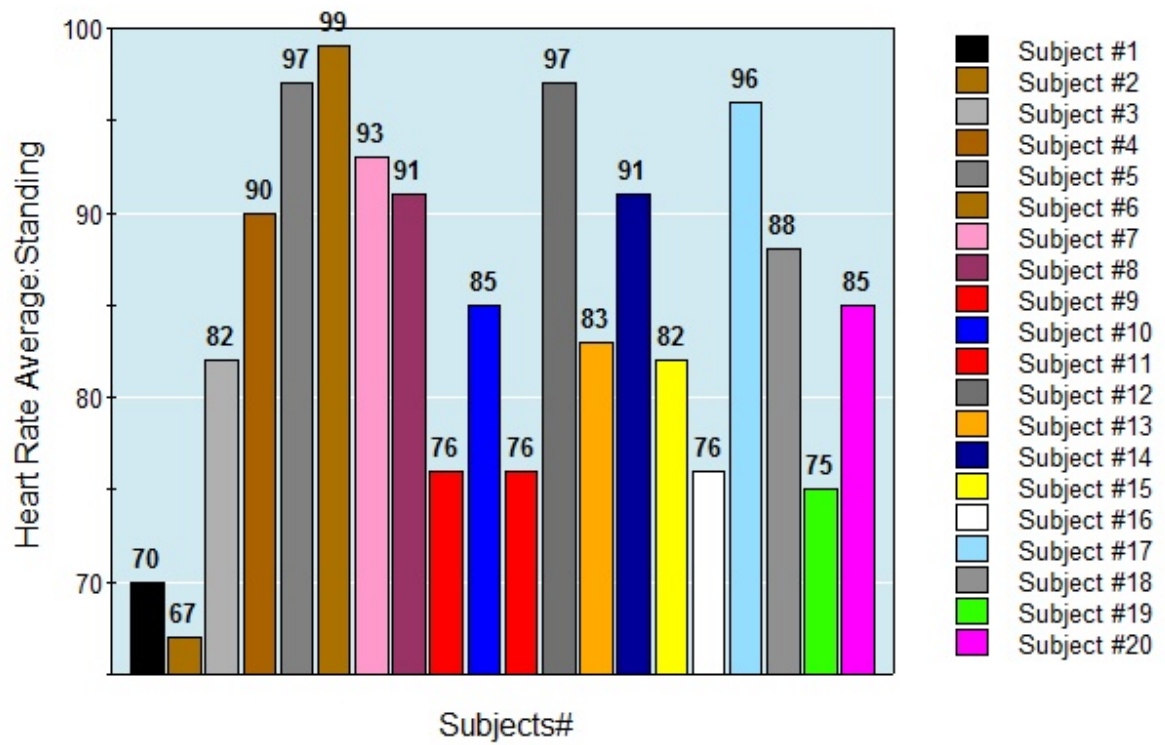


Figure 4: Showing Average Heart Rate (Standing)



## What effects does Exercise have on the heart

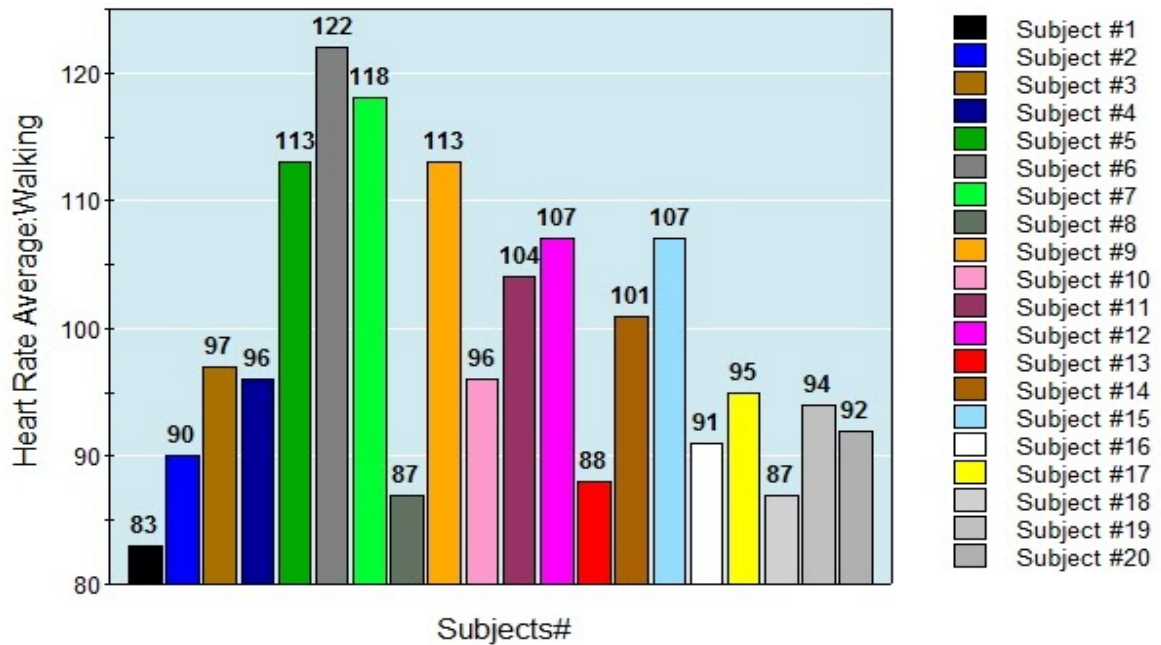


Figure 5: Showing Average Heart Rate (Walking)

## What effects does Exercise have on the heart

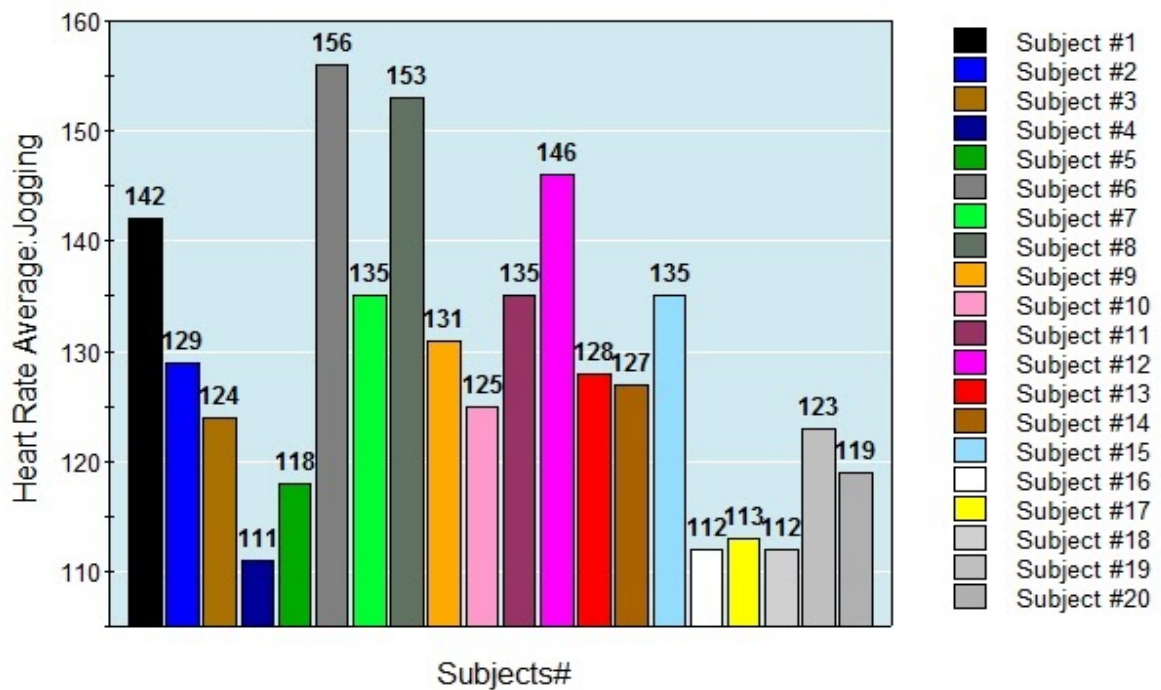


Figure 6: Showing Average Heart Rate (Jogging)

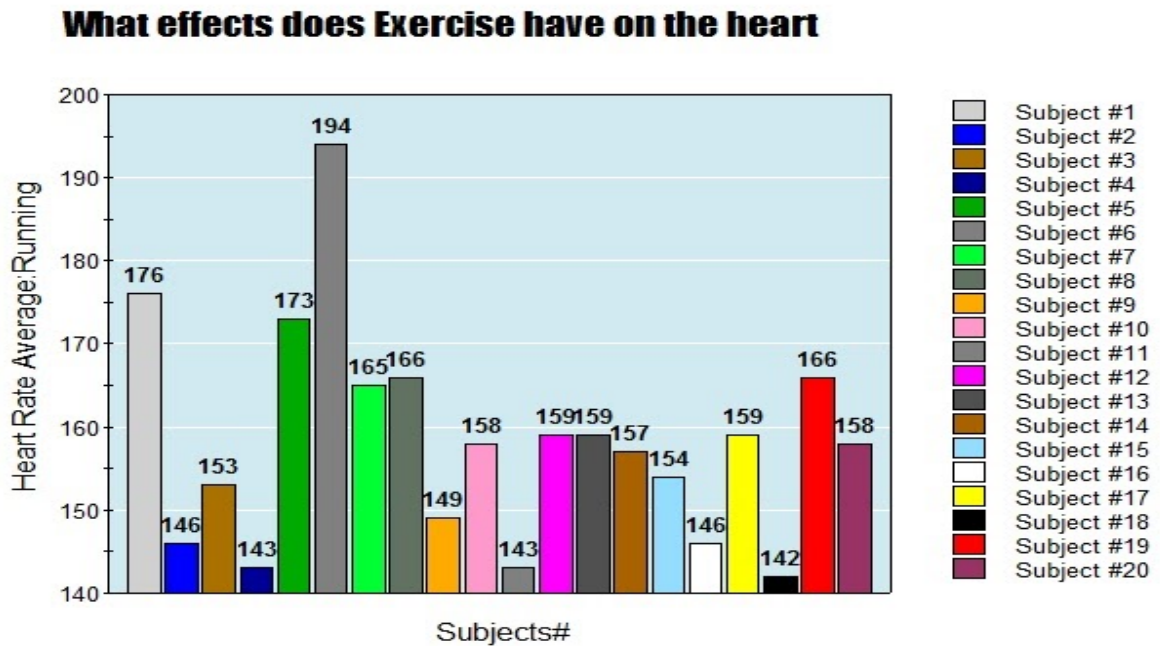


Figure 7: Showing Average Heart Rate (Running)

## 9.0 Conclusion

In view of the data that I collected for this experiment; my first hypothesis was correct. For every person that has participated in the project, running had the highest heart rate when compared to other activities.

For the second hypothesis the average heart rate of the children is 160 BPM while that of adults was 155 BPM. The difference between them is not a significant one, and this is part of what I researched that as children grows, their heart rate is almost as that of an adult (please refer to introduction). This shows that the second hypothesis is incorrect.

The third hypothesis “As the body position changes, so does the heart rate.” This hypothesis is true as can be seen in the tables above. The heart rate changes from sitting, standing, walking,

jogging and running in ascending order. This shows that as the intensity of the exercise increases, so does the heart rate.

In conclusion, to answer my scientific questions, which says “what effect does exercise have on heart rate”; I have concluded that as the exercises become more intense the heart rate increase. Also, age, body position and the type of activity being carried out will also have an impact on the heart rate.

### **9.1 Application**

Exercise is good for the body and in order to make sure that we get the very best from exercising or one’s workout session, it is important to know the safe zone and monitor how hard your heart is working. In a sitting position which is the resting position, if your heart rate is higher than normal, it can be an indication that something is wrong.

To maximise one’s workout, it is good that one reaches their target heart rate which leads to a greater fitness level. This experiment will ensure that people know how different exercises affect their heart rate and how they can get to their target heart rate at a safe zone.

### **9.2 Further Questions**

How would the heart rate of individuals under this age group that were considered for my project be, if they were obese? This is something I would want to explore in the near future to know the outcome.

### **9.3 Improvement to Project**

One area of improvement would be to have a wider range of age groups to include a lot of people in order to get a wide range of data set.

#### **9.4 Guidebook and Timeline**

January 28- finished setting up binder

February 2- finished my scientific question and got journal

February 3- furnished journal

February 10- finished variables

February 11- finish research paper

March 1- started experiment

March 9- finished experiment

March 10 – started and finished observation and data collection

March 13- did conclusion and graphic representation and mean, median and mode.

March 14- started and finished application, further questions, improvement to project and guidebook and timeline.

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## **Glossary of Words**

**Beats Per Minute (BPM):** The number of times the heart beats in one minute.

**Target Heart Rate:** The minimum number of heartbeats in a given amount of time in order to reach the level of exertion necessary for cardiovascular fitness, specific to a person's age, gender or physical fitness

**Maximum Heart Rate:** This is the maximum number of beats made by your heart in one minute. This can be calculated using this formular:  $220 - \text{Age}$  (the person's age)

**Resting Heart Rate (RHR):** This is the number of times your heart beats per minute while at complete rest. As the fitness level improves, the RHR reduces.