Sample: Biology - Laboratory Report

Introduction

The aim of the experiments was to observe the impact various effects have on heart rate. Diurnal changes, postural changes and thermoregulatory changes were viewed and the effects they had on heart rate were recorded.

Various factors can affect the heart rate. However, in each case changes in the heart rate caused by different factors have an adaptive value. A number of studies have already been performed to represent the changes in heart rate with respect to action of particular factors. Some of the experiments carried out in the past appeared to be incorrect when tested again. For example, in the experiments performed on frogs it was investigated that heart rate depends on the temperature. However, more recent data indicate that there is no such correlation (Taylora E.T. et al. 2012) Increase in temperature makes heart beating faster while decrease in temperature makes it beating slower. In addition, it is a well-known fact that heart can be slowed down when significant pressure is applied to eyes. This feature is well-known as Dagnini Aschner or oculocardiac reflex (Levine J.M. et al. 2012)

Thus, there are a lot of factors that can affect the heart rate and in the current experiment we tried to evaluate the impact of some factors and compare them with already known facts and theories.

Generally heart rate is lower when sleeping compared to being awake (Meier N. 2013.). Heart rate will be lower before getting up in the morning than it will be before falling asleep. Metabolic rate of the body slows when sleeping because the heart doesn't need to work as hard. Before going to sleep the bodies metabolic rate is still high so the heart rate although not high, should still be working harder than when first awakening after a night's sleep. Thus, we suspected to observe the higher heart rate in the evening and the lower one in the morning. The hypothesis we testes sounded as follows: heart rate in the evening is statistically significantly higher than the heart rate observed in the morning.

Heart rate will spike with a sudden movement such as standing up quickly. The body uses many skeletal muscles when standing up; the heart needs to supply

these muscles with more blood and oxygen. Once standing the muscles no longer need as much oxygen so the heart can slow down again. Thus, our hypothesis for this experiment stated that heart rate increases when person stands up and decreases when the person sits down.

When limbs are exposed to warm water, heart rate will increase. When limbs are exposed to cold water, heart rate will slow.Generally, heart rate slows when the body is cold and speeds up when hot. This creates Homeostasis and the heart changes its rate to keep the bodies internal temperature constant. Therefore, we suspected that cold water causes increase in the number of heart beats per minute while warm water decreases them.

These data are well-known and easily-deductible. However, still we tested them in order to persuade in their correctness and obtain our own reliable results.

Materials and Methods

Equipment List

- Test Subject - Male, 31 years old, fit and healthy.
- Large Plastic Bucket
- Stopwatch or Clock
- Thermometer - Monitor water temperature
- Warm Water - 37°C
- Cold Water - 10°C
- Ice - assist in maintaining water temperature

Diurnal Variation

The subject was made to relax in a lying down position, for 5 minutes. Pulse was then taken over 30 seconds, then multiplied by 2 to determine heart rate in BPM. Measurements were taken over a 7-day period from the 27th August 2012 till the 2nd September 2012, before rising in the morning at 6am and them again before falling asleep at 11pm.

Postural Changes

Relaxing in a supine position for 5 minutes, the subject's heart rate was measured in BPM. The subject then stood upright quickly and heart rate was measured again. Remaining in a standing position, heart rate was measured again after 2 minute and then again after 4 minutes.

Thermoregulatory Changes

Relaxing in a sitting position for 5 minutes, the subject's heart rate was measured in BPM. The subject then placed hands and forearms in a bucket of warm water (water temperature at 37°C). Heart rate was then measured after 10 minutes, 20 minutes and 30 minutes. The same experiment was then repeated using cold water (water temperature at 10°C).

Results

Diurnal Changes

The results showed an average of 44.43bpm (beats per minute) at 6am and an average of 49.86bpm at 11pm. The results show a clear change in heart rate between morning and evening, showing an average of 10.85% (Table 1). It can be clearly seen that heart rate is much higher in the evening compared to the morning in (Figure 1).

Table 1: Diurnal Changes in heart rate of a 31year old male over 7 days.

Date	Day	Morning (6am) BPM	Evening (11pm) BPM	Difference (BPM)	Percentage (%)
27-Aug	Monday	44	51	*7*	*14*
28-Aug	Tuesday	45	50	*5*	*10*
29-Aug	Wednesday	45	49	*4*	*8*
30-Aug	Thursday	44	51	*7*	*14*
31-Aug	Friday	44	50	*6*	*12*
1-Sep	Saturday	45	49	*4*	*8*
2-Sep	Sunday	44	49	*5*	*10*
	Average	**44.43**	**49.86**	**5.43**	**10.85**

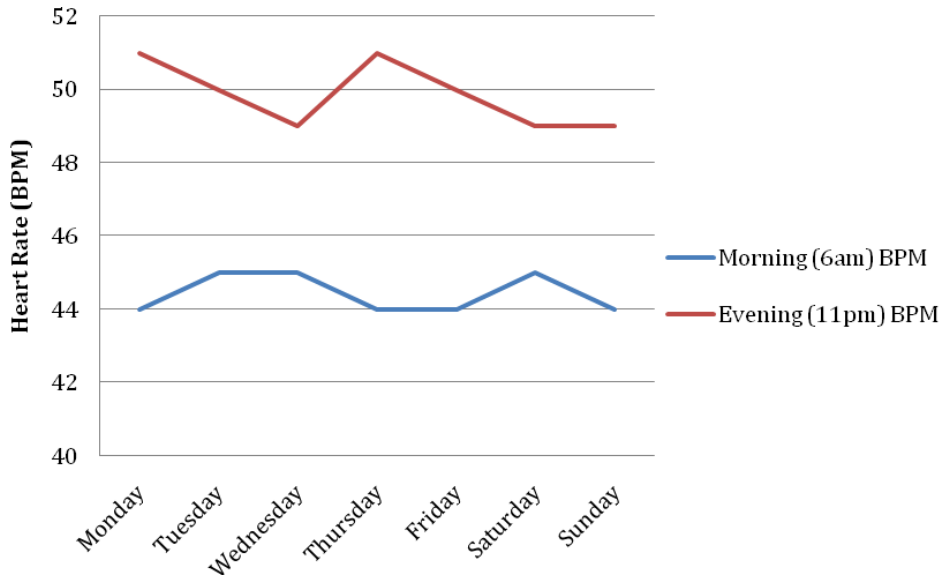

Figure 1: Diurnal Changes in heart rate of a 31year old male over 7 days.

Postural Changes

The results of the experiment showed a peak in heart rate of 20bpm from 48bpm to 68bpm when first standing up (Table 1). After 2 minutes the heart rate showed a decrease of 7bpm to 61bpm and then another 5bpm after 4 minutes to 56bpm as seen in (Table 1). (Figure 2) shows the clear peak in heart rate, followed by a steady lowering of heart rate.

Table 2: Postural Changes affecting heart rate in a 31 year old male.

Time	Position	BPM	Difference
0min	Supine	48	0
0min	Stand Up	68	20
2min	Stand Up	61	-7
4min	Stand Up	56	-5

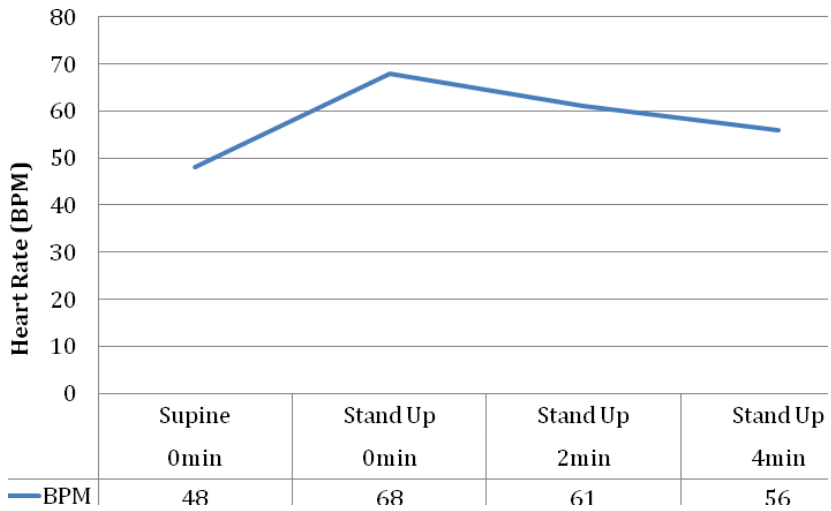

Figure 2: Postural Changes affecting heart rate in a 31 year old male.

Thermoregulatory Changes

The results of the warm water experiment reflected a peak of 11bpm from 51bpm to 62bpm after 10minutes, and then slowed back by 6bpm to 56bpm after 20minutes and then after 30minutes the heart rate had slowed another 4bpm to 52bpm (Table 3.1).The experiment was then repeated but the water temperature was at 10°C. The results showed a similar peak at the 10minute mark as previous of 12bpm from 52bpm to 64bpm, but then instead of slowing, the heart rate increase another 2bpm from 64bpm to 66bpm at the 20minute mark, and then increase a further 2bpm form 66bpm to 68bpm at the 30minute mark (Table 3.2). (Graph 3) shows a clear difference between being exposed to warm water versus cold water. When the subject was exposed to cold water the heart rate remained elevated over the 30minute period.

Table 3.1: Thermoregulatory changes in heart rate when exposed to warm water for a 31 year old male.

Time	Position (Water @ 37°C)	BPM	Difference
Start	Prior Submerge	51	0
10min	Submerged	62	11
20min	Submerged	56	-6
30min	Submerged	52	-4

Table 3.2: Thermoregulatory changes in heart rate when exposed to cold water for a 31 year old male.

Time	Position (Water @ 10°C)	BPM	Difference
Start	Prior Submerge	52	0
10min	Submerged	64	12
20min	Submerged	66	2
30min	Submerged	68	2

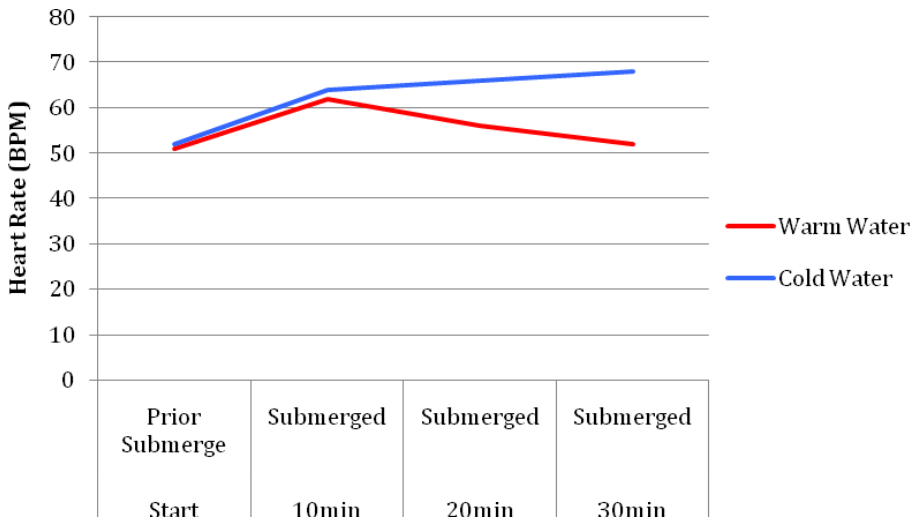

Figure 3: Thermoregulatory changes in heart rate over a 30 minute period for a 31 year old male.

Discussion

The results of these experiments show how different variables can affect heart rate. Three different variables were tested which were diurnal changes, postural changes and thermoregulatory changes.

Diurnal changes, indicated a lower heart rate after waking up than before going to sleep. Heart rate reduces as sleep becomes deeper, elevating slightly once awaking (Kawada 2011). The slowing of the metabolic rate slows when sleeping, not needing the heart to work as hard (Green 2011). Such correlation can be explained by the fact that metabolic rate relies on oxygen income. Oxygen is taken into the organism by the respiratory system and then carried to different organs and tissues. When metabolic rate is low, heart rate can be low (Meier N. 2013). The results supported the hypothesis, showing a higher heart rate before sleeping versus waking up in the morning. The experiment was performed accurately, although performing the experiment across several subjects would provide more credibly to the experiment.

In experiment two, postural changes were observed, supporting the hypothesis, heart rate spiked with the initial movement from a supine position to a standing

position. Movement from the supine position to a standing position commonly prompts an increase in heart rate (Valentini&Parati 2009). The experiment would not need to be repeated or improved as the results proved to be clear and accurate. However, the research is limited because of the low number of participants. A larger population should be studied; however, our results are likely to be applied to all the human population. Only healthy individuals can be considered to be subjected to our data. Obese people are not likely to be subjected because heart rate can be altered by excess weight (Simpson K.M. 2011)

Thermoregulatory changes were observed in experiment three. In both warm water and cold water heart rate increased, it was observed though that over a 30 minute period, heart rate stayed increased in the cold water where as the warm water slowly returned back to the starting heart rate. Increase in heart rate in cold water can be explained by the organism's attempts to compensate the low temperature and contribute to internal temperature increase. This experiment could have several improvements to the improve accuracy of results. Firstly the water temperature was not maintained through out the experiment, which could have affected the results. Possibly using an esky instead of a bucket to insulate the water may maintain the temperature longer. Secondly, the recording of heart rate could be improved using a heart rate monitor, which would offer instant readings of heart rate and remove human error.Heart rate continually changes from the effect of a variety of factors (Kawado 2011).

Thus, our experimental data coincide with the general experimental data obtained by other researches. An interesting study would be carried out if heart rate would be tested in obese people and people with normal weight. A study has already been carried out in this field (Karason K., 1999) and it would be interesting to repeat those results.

References:

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