

# [Effects of time of day on speed of recovery heart rate](https://assignbuster.com/effects-of-time-of-day-on-speed-of-recovery-heart-rate/)

* Anita Massoudi

### Investigating the effects of time of day on the speed of recovery heart rate to resting levels after exercise

## Introduction and rationale

The purpose of the following investigation is to establish whether there is any relation between the recovery of one’s heart rate to resting levels after performing cardiovascular exercise, and the time of the day that such exercise is performed.

Scientific research has long showed that exercise plays a crucial role in the health and fitness of all, from improving to maintaining one’s health and fitness. Various types of exercise, ranging from those considered “ gentle” to “ vigorous” provide a wide range of health benefits. However, whilst any form of physical activity is generally promoted, the most encouraged form is that of cardiovascular (aerobic) exercise.

Cardiovascular exercise differs from other types of physical activity. It is defined as “ any exercise that raises your heart rate.” [1] This is where the importance of such exercise lies. By forcing the heart to work harder, the heart muscle must beat more frequently and powerfully to transport oxygen and nutrients via the blood, to all the hard working muscles of the body. Practicing regular exercise results in the strengthening of the muscles involved; including the heart and those of the lungs. The heart muscle becomes stronger and more efficient at pumping blood around the body, resulting in less effort and requiring fewer beats per minute to perform its task. Similarly, the development of stronger, more efficient lungs, results in more oxygen being taken in per breath and again, fewer breaths needed per minute.

Regular exercise combined with a sensible, balanced diet has been scientifically proven to reduce the risk of developing cardiovascular disease. It helps to reduce an individual’s risk by preventing the development of, and lowering existing, high blood pressure. Exercise is also used as a tool to combat obesity and also increase HDL blood cholesterol levels, which aid in the removal of LDL cholesterol from the arteries [2] . High blood pressure, obesity, increased LDL blood cholesterol levels and inactivity have all been linked to an increased risk of developing cardiovascular disease [3] . Obesity is associated with a poor diet and inactivity. Inactivity causes high blood pressure, which can damage the walls of the arteries, leading to atheroma formation and increasing the risk of cardiovascular disease, whilst a diet high in saturated fat increases blood cholesterol levels. High blood cholesterol levels and high LDL blood cholesterol levels also increase atheroma formation and increase an individual’s risk of developing cardiovascular disease [4] .

Developing a dedicated exercise routine has also been linked to improvements in emotional wellbeing, as mentioned in this article from the AHA (American Heart Association): “ Cross-sectional studies reveal that, compared with sedentary individuals, active persons are more likely to be better adjusted…Exercise also improves self-confidence and self-esteem, attenuates cardiovascular and neurohumoral responses to mental stress, and reduces some type A behaviors.” [5] Exercise is therefore vital to improving and preserving one’s all-around health.

Based on continuous scientific findings, government bodies and the media actively encourage both adults and children of all ages to partake in some form of physical activity. They achieve this by educating the public, informing them of the risks they may face if they do not take action and by providing them with guidelines based on an individual’s age. For example, the NHS advises individuals between certain ages of the activity goals that they should strive to achieve. A list of possible options are provided, composed of a range of various exercise methods performable by all and varying lengths of suggested performance time, in order to help people meet these targets [6] . It is in fact these very guidelines, which have formed the premise of this investigation.

It remains an unfortunate fact that while these beneficial targets do exist, there are numerous individuals who find it increasingly difficult to achieve these health related goals. In particular, adults have a number of responsibilities which cannot be ignored, varying from the necessity to attend work in order to earn a wage to survive, to caring for children or other individuals that they may be responsible for. Often left with the energy to carry out very little else, there are some that find it both challenging and almost impossible to make this dedicated time for the improvement of their health.

A factor that plays an even larger role in this dismissal is the accompanying fatigue. If one is not accustomed to partaking in more strenuous activity than normal, exercise can be an extremely tiring affair. Tiring enough, that for those with important commitments due their attention soon afterwards, it is very easy for the average person to find an excuse to skip exercise, in order to have sufficient energy to perform other tasks that they deem more important. I feel that because of this, exercise is seen by many as an unwanted “ chore” of sorts.

Thus the true aim of my investigation is to analyse whether there is a preferable time of day to carry out exercise, where the recovery of one’s heart rate is the quickest, returning to normal levels within the expected period of time. It is said that one hour after ceasing cardiovascular exercise, the heart rate of a healthy individual should return to resting levels [7] . Does a particular time of day affect how quickly or slowly this recovery to resting levels takes place? This may be a very important factor to consider in terms of when exercise should be best performed. I am drawn to believe that the slower the recovery after exercise, the more exhausted, less able and less motivated an individual will be in performing any further tasks. This in turn will have negative effects, most notably leaving them less likely to exercise at that particular time and in the worst case, choose not to exercise at all.

Experimental Hypothesis: Different times of the day will affect the speed of heart rate recovery to resting levels.

Null Hypothesis: Different times of day will not affect the speed of heart rate recovery to resting levels.

## Planning the Experiment

As a private candidate without access to a laboratory or any scientific apparatus, this plan has been devised in accordance to the limitations that I face. Bearing this in mind, the test subject for this experiment is a 32 year old female, being myself. In order to collect reliable data, it was decided that a heart rate reading will be taken at the beginning of each day of the investigation, upon waking at the exact same hour, in order to obtain a resting heart rate for the subject involved. This reading will be taken with the use of a stop watch function on a mobile phone, to provide the best accuracy in timing possible and by counting the number of heart beats in ten seconds. A pulse will be taken during this time, by using the second and third finger resting on the artery inside of the wrist, and the figure recorded would then be multiplied by ten to calculate the beats per minute.

Moderately intense exercise will then be performed for thirty minutes at a set time of the day. Exercise will be carried out using an exercise bike equipped with heart rate sensors on the handle bars, to ensure that the subject involved reaches the suggested heart rate to provide the cardiovascular benefits for her age. In this instance, the target heart rate zone for the subject’s age is between 95-162 beats per minute, as suggested by the AHA [8] . Two minutes after exercise has ceased, the subject will measure their pulse again in a similar manner, to measure their recovery heart rate and then exactly one hour later, to ensure that heart rate has returned to resting levels. This initial investigation will cover a span of four days, with each day consisting of a thirty minute period of exercise carried out at a specific time, in either the morning, afternoon or evening. The fourth will act as a control day, where no exercise is performed at all. The chosen times will be 9am, 1pm and 6pm.

After consideration, the following variables will be controlled, which could affect the heart rate of the individual. The subject will rise at the same hour each day. The times that food will be consumed and the size of the portions will be the same before exercise and readings taken, as large portions can cause an increase in heart rate and digestion of regular portions causes heart rate to decrease [9] . The only food permitted before readings will be food of sensible portions, consumed half an hour before exercise is performed.

Caffeinated drinks, such as tea, coffee, soda and other artificially or naturally stimulating drinks will be replaced with water alone. Foods that are sources of caffeine, such as chocolate shall also be omitted. The subject will also avoid assuming certain body positions, such as lying down or sitting and then suddenly standing before taking a pulse reading, as these actions can cause a spike in heart rate [10] . The only form of exercise used in this study will be performed on an exercise bike, using the same bike, the same intensity settings and for the same length of time during each session.

The subject will not perform any activities before taking a reading, other than the scheduled exercise, that may affect readings – such as climbing stairs or walking around. The temperature of the environment shall also be controlled, as well as the clothing worn during exercise. The subject will also not be allowed to lie down or nap at any time before performing any exercise. There will also be a control day during which the subject shall abide by all of the above, but shall partake in no exercise at all. Readings on this day will be taken at the exact same times to ensure that any changes in heart rate are due to the exercise and not the subject herself.

In terms of risk assessment, before each scheduled exercise, the area around the exercise bike must be cleared, to avoid any trips or slips. The subject must eat half an hour before performing, to avoid any dizziness and provide sufficient energy for the task at hand. The subject will not push past any physical limits and if any chest pain, dizziness or nausea is experienced, exercise will stop immediately and medical advice will be sought. The subject will wear suitable clothing designed for the purpose of such activity; so as to avoid any accidents or discomfort. Long hair will be tied back, as to avoid getting caught in any mechanisms and suitable shoes will also be worn, to prevent injury. The exercise session will also consist of a five minute warm up and cool down period at the beginning and end, to avoid personal injury. The subject must also remain hydrated. Water should be consumed before, during and after to prevent dehydration or fainting.

Before the main experiment, a trial was carried out during the morning, in accordance to the methods listed above. A resting heart rate of 66bpm was recorded at 8am. The subject then cycled on a medium to high intensity from 9am – 9: 30am and a recovery heart rate of 108bpm was noted two minutes after exercise had ceased. Exactly an hour after this reading was taken, the heart rate had returned to resting levels. This single reading obtained after the recovery heart rate had provided no indication of the speed of recovery. However, it had been confirmed that in the case of the subject, an hour was long enough for the resting heart rate levels to be reached once more. Based on this, the experiment was then modified accordingly. Throughout the main experiment, the subject’s pulse would be recorded every ten minutes after the recovery heart rate had been recorded, for a period of sixty minutes. During this sixty minute period, the subject would remain seated and still, so as to not cause any interference with the readings. It was decided that taking readings in these smaller intervals, would provide results that could better demonstrate a clearer idea of the true time in which resting heart rate levels may return. The main experiment was carried out adopting these new measures and repeated two more times, to ensure the best results were obtained and from them, to calculate a mean and present the final table of results.

## Results

Morning Readings

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Time of Day  | Heart Beats Per Minute (BPM)  |  |  |  |  |  |  |  |
| Morning  | Resting Heart Rate  | Recovery Heart Rate  | 10 mins later  | 20 mins later  | 30 mins later  | 40 mins later  | 50 mins later  | 60 mins later  |
| First Reading  | 130  | 180  | 170  | 160  | 150  | 140  | 140  | 130  |
| Repeat 1  | 130  | 170  | 170  | 160  | 140  | 140  | 140  | 130  |
| Repeat 2  | 120  | 160  | 150  | 150  | 140  | 130  | 130  | 120  |
| Control Reading  | 120  | 130  | 120  | 120  | 120  | 120  | 120  | 130  |
| Control Repeat 1  | 130  | 120  | 130  | 120  | 120  | 120  | 130  | 130  |
| Control Repeat 2  | 130  | 130  | 130  | 130  | 120  | 120  | 120  | 130  |

Afternoon Readings

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Time of Day  | Heart Beats Per Minute (BPM)  |  |  |  |  |  |  |  |
| Afternoon  | Resting Heart Rate  | Recovery Heart Rate  | 10 mins later  | 20 mins later  | 30 mins later  | 40 mins later  | 50 mins later  | 60 mins later  |
| First Reading  | 110  | 150  | 150  | 140  | 130  | 120  | 120  | 110  |
| Repeat 1  | 120  | 160  | 160  | 150  | 140  | 130  | 130  | 120  |
| Repeat 2  | 120  | 150  | 150  | 140  | 140  | 130  | 130  | 120  |
| Control Reading  | 120  | 130  | 130  | 130  | 120  | 120  | 120  | 120  |
| Control Repeat 1  | 120  | 130  | 130  | 120  | 120  | 120  | 130  | 120  |
| Control Repeat 2  | 130  | 130  | 130  | 120  | 130  | 130  | 120  | 130  |

Evening Readings

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Time of Day  | Heart Beats Per Minute ( BPM)  |  |  |  |  |  |  |  |
| Evening  | Resting Heart Rate  | Recovery Heart Rate  | 10 mins later  | 20 mins later  | 30 mins later  | 40 mins later  | 50 mins later  | 60 mins later  |
| First Reading  | 120  | 150  | 150  | 140  | 140  | 140  | 130  | 120  |
| Repeat 1  | 120  | 140  | 140  | 140  | 130  | 130  | 130  | 120  |
| Repeat 2  | 130  | 150  | 150  | 150  | 140  | 140  | 140  | 130  |
| Control Reading  | 120  | 130  | 130  | 130  | 130  | 120  | 120  | 120  |
| Control Repeat 1  | 130  | 140  | 130  | 130  | 130  | 120  | 120  | 130  |
| Control Repeat 2  | 120  | 130  | 130  | 130  | 130  | 130  | 120  | 120  |

Final Table of Results

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Heart Beats Per Minute (BPM)  |  |  |  |  |  |  |  |
| Time of Day  | Resting Heart Rate  | Recovery Heart Rate  | 10 mins later  | 20 mins later  | 30 mins later  | 40 mins later  | 50 mins later  | 60 mins later  |
| Morning  | 127  | 170  | 163  | 157  | 143  | 137  | 137  | 127  |
| Afternoon  | 117  | 153  | 153  | 143  | 137  | 127  | 127  | 117  |
| Evening  | 123  | 147  | 147  | 143  | 137  | 137  | 133  | 123  |
| Morning Control  | 127  | 127  | 127  | 123  | 120  | 120  | 123  | 130  |
| Afternoon Control  | 123  | 130  | 130  | 123  | 123  | 123  | 123  | 123  |
| Evening Control  | 123  | 133  | 130  | 130  | 130  | 123  | 120  | 123  |

## Evaluation and Conclusion

From the recorded results, it can be observed that the resting and recovery heart rates varied, but the time that it took for the heart rate to return to resting levels after exercise, remained the same for each given scenario: sixty minutes. Based on these results, it can be concluded that the time of day has no effect on the return to resting heart rate levels after exercise.

These results however are severely limited and not representative of all females of the same age group, nor were any men involved in the duration of this study. The conclusion can only be applied to the particular subject involved. In this instance, the subject is at the lower end of the Body Mass Index for her height, has no family history of heart disease, is in good health and is at an adequate level of fitness, due to a physically demanding place of work.

If there was opportunity for the study to be repeated and a larger number of test subjects available, it would have made the results and thus the conclusion more reliable for this particular gender and age group. More interesting still, would have been to compare the results of both men and women within this age group, to see if the return to resting heart rate levels differs between genders. Although it must be acknowledged that even if such a collection of individuals were available for participation, regardless of the variables which could be kept constant, there are numerous factors beyond perceivable control that may and can affect heart rate.

Different individuals have varying amounts of stresses in their life, which may in turn affect their heart rate. In this day and age, due to the pressures of life, there are many who also have trouble acquiring a restful night’s sleep; another factor which has been linked to changes in heart rate [11] . People may take certain forms of medication or there may be genetic factors, as well as differences in existing fitness levels between individuals that may affect readings obtained. Therefore it can be noted that whilst results obtained from a single individual are most certainly not reliable enough to make a sound conclusion, the results that could be obtained from a larger number of subjects may still be influenced by a range of the aforementioned and the unknown.

Regardless of whether or not the speed of recovery to a resting heart rate is indeed affected by the time of day, there is one conclusion that can be safely made. The right time to partake in exercise is down to the individual and when their life schedule and circumstances permits them. Whether it be morning, afternoon or evening every day, a few times a week or maybe just the once. For no matter when or how an individual choses to partake in some form of exercise, it is always one step closer towards improving and conserving one’s health.

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