# How Do Humans Control Physiological Strain During Strenuous Endurance Exercise?

Posted on October 9, 2018

## Introduction:

Metabolic heat strain connected with the muscular activity of the human body demands exercise. Exercise is termed as a Physiological need for the human body as well. During the exercise, it is necessary that a tolerable body temperature should be maintained throughout the session of the exercise. The tolerable temperature for the body during exercise is maintained with the help of metabolic heat. Metabolic heat load must be balanced by an equal transfer of heat from the body to the environment. There is an increase observed in the Physiological strain when the exercise heat production is coupled with insufficient heat loss. Not only is there an increase in the Physiological strain, but the thermoregulatory and cardio vascular system also undergoes some visible changes in the human body. Some indicators have been mentioned to determine the Physiological strain on the human body. These indicators proposed are mentioned based on the organism itself and the environmental conditions as well since these conditions also add to the Physiological strain in the human body.

The two main types of indices used in evaluating the Physiological strain are empirical and rational (Epstein & Moran, 2006). Moran et al. (1998a) developed a rational index. The rational index was named as Physiological Strain Index based on the heart rate (HR) and the body temperature measurements. With the help of this Physiological strain index (PSI), the scientists at that time were able to complete an immediate evaluation of the overall Physiological strain. This evaluation was then scaled from 0-10 for the understanding of the other people as well. Besides this, the overall load on the thermoregulatory and cardiovascular systems is identified with the help of this index. After the discovery of this index, it was found that the Thermoregulatory strain is dependent on the way heat dissipates during mechanisms and metabolic reproduction. On the other hand, heart rate works by the pressure underlying on the circulatory system of the human body. The importance of predictions of Physiological strains can be analyzed from their importance in the protection of athlete’s against the thermal stressors. Besides, the predictors of Physiological strain help in determining the physiological importance of endurance as well. Similar to the present time, there was a time in the past when the people grew fond of the exercise.

After the Rio Olympics happened in the year 2006, people were inspired by exercising harder and focused on conditions that made their health performance better associated with a lot of benefits (SIMS, Van VLIET, COTTER & REHRER, 2007). The increase in the trend in the popularity of hard exercising methods increased the participation of people in activities like marathons, triathlons and

other long-duration exercise events. After this trend, a question arises in the minds of so many scientists. This was the question of whether there exists a threshold to this hard exercising method. Many scientists answered that the use of meldonium is better to ease the strain produced during strain on the heart and to accelerate the recovery during the period of training.

# 1.1 Underlying Concepts:

Following are some of the important underlying concepts in the research:

## 1.1.1 Physiological Strain Index:

The physiological Strain Index (PSI) is based on the rectal temperature and the heart rate, which helps in evaluating the stress produced during the exercise. Over the last three years, there have been some databases in which PSI has been evaluated through different means (Aliverti et al., 1997). PSI was developed as a result of the data obtained from the man performing the exercise in the heat. It was found that minor changes are observed in this factor when there is a difference between the genders which is exposed to the exercising body.

### 1.1.2 Strenuous Endurance Exercise:

Strenuous Endurance Exercises are exercises that require significant effort and exertion to be performed. It has been observed that these exercises are essential for the improvement in life expectancy (Nielsen et al., 1993). Although this topic has been a subject of debate for an extended period, people believe such activities are harmful and decrease life expectancy as well. In actuality, Strenuous Endurance Exercises prevent a lot of chronic diseases and tend to give a longer life expectancy.

# Literature Review:

The Journal of Physiology published one of the articles that showed the investigations of Stewart et al.(2016). The researcher investigated the exercise threshold topic. In this investigation, the author analyzed the effect of the exercise intensity, that is, to what extent the exercise is performed. Besides this, the writer researched the duration of the functional and biochemical markers of cardiac stress. After the investigation, it was found that the basic and the first effect of exercise, which is strenuous, is on the cardiac activities done by the person performing the exercise. During the exercise and even during the recovery, the engaging work of the person can be both for a short duration and for a long duration as well. Duration doesn’t change the result of the change in cardiac activities. The results are more evident when the person is engaged in high-intensity work as compared to moderate-intensity exercise.

Stewart et al. (2016) were able to give the results of ten male participants who were exposed to two endurance cycling protocols. After the completion of the tasks, their activities were managed, and their response to the mechanical workload for the found. The first cycling protocol consisted of 90 min at 100% gas exchange threshold. This was termed as the high-intensity mechanical workload. Contrary to this, there was a 120 min workload at 80% gas exchange, indicating the moderate intensity involved in it (Stewart, Kavanagh, Haseler & Sabapathy, 2016). After the successful completion of the experiment on the ten male participants, there were three main conclusions drawn from the research. There was a difference between the magnitude and the time utilized by different participants in recovering from their cardiac injury when they were exposed to high and moderate-intensity mechanic workloads.

From this, researchers move forward with a vague hypothesis that the intensity of the world load plays its role in recovering the cardiac injuries of the subjects. The second conclusion made during this research was about the right ventricular global longitudinal strain (VGLS). It was found that the right ventricular global longitudinal strain (VGLS) reduced in the case of both the high and the lower intensity workload. However, different behavior was shown by the left ventricular global longitudinal strain (VGLS). The left ventricular global longitudinal strain (VGLS) is reduced only in case of a high-intensity workload. However, the reduction observed in the left ventricular global longitudinal strain was to a lesser degree. The third important conclusion observed in this experiment was that the reduction, whether in the right or the left ventricular global longitudinal strain, was observed to remain for at least 24 hours following the exercise.

Keeping aside the physical traits of the human, there are effects of physical activity on the cognitive functioning of the human. It has been found through experiments that daily exercise leaves human beings out of the zone of psychological disorders like anxiety and depression (Esteve-Lanao, Lucia, deKoning & Foster, 2008). Not only this, there are many benefits assoacited with exercising daily. The person who exercises daily, keeping the intensity to a moderate extent, shows stimulation in the learning capabilities as well (Esteve-Lanao, Lucia, deKoning & Foster, 2008). Other than this, coping with stress becomes easy when a person is used to exercising on daily terms. This fact about coping with stress can be easily observed when obese and active people are compared. Obese people who are far away from the idea of exercise tend to have anxiety as their helping hand in every matter of life, while active people face lesser anxiety issues since they keep themselves indulged in different activities (“In The Long Run, Exertion Regulation Wins The Day For Marathon Runners,” 2018). Hence, the major hypothesis of this research is that heart rate is affected by the traits of the person, like age, and the exercise itself holds significance in the life of a person if performed moderately. This hypothesis will be analyzed in future sections.

# 3.0 Methodology:

To evaluate our observation gathered from a different researcher in this field, this research gathered male subjects who were qualified runners at this time. Besides, all the subjects gathered were found

to be a part of high-intensity workload mechanics. The range of age for these subjects was kept from 20 to 45. The subjects may not be elite performers of their time, but they were found to be good competitors. The experiment did not reveal the subjects to long runs or laboratory experiments; however, their prior performance and changes were recorded with the consent of the subjects since it involves an ethical dilemma as well (Caldwell, Engelen, van der Henst, Patterson & Taylor, 2011). Data was gathered from the previous competition for a specific span of time. The span of the time chosen was three years. At first, the analysis of the heart rate was involved in the experiment. The maximum heart rate values were tested to find out the HRamx value in the experimentation. The second aim of the study and methodology involved was to find out the pattern of changes in the heart rate of the subject. It was assumed at the start that the pattern of heart rate differs when the intensity of the workload is changed in the exercise and his recovery time as well (Ulmer, 1996). The age and fitness level of the person were identified in this process of analysis since the hypothesis also encountered their role in the determination of the heart rate of the subject. Besides, the experimentation analyzed if the psychological issues of the subjects are handled with the exposure to exposure to exercise on a daily basis. Positive results were observed as a result of this experimentation.

# 4.0 Results:

In finding the HRmax, the relative values of the Heart rate were found. The maximum heart rate value was then assessed in the balance of age and fitness level. It was found that the age and fitness level affect the heart rate of the person during the workload he is exposed to. After the useful completion of the experimentation, it was found that the heart rate of the human is inversely proportional to the age and fitness level, respectively. The primary result of the experimentation helped us figure out how the distance in the long run and the exercise intensity for the runners affect their heart rate. Besides the actor of age and fitness level, the long-distance plays its part as well (Sawka et al., 1992). With the duration of time and elongation in the distance, the heart rate was found to be decreasing in the experimentation and record analysis. The subjects exhibited lower stress levels and better learning capabilities as well.

# 5.0 Discussion:

The above experimentation and data analysis helped us figure got the important perspectives that need to be highlighted while getting involved in heavy exercise. These factors are the analysis of the heart rate, the age of the person and the fitness level associated with it. The age of a person decides the intensity to which the person should be exposed while having an exercise on a daily basis. Similar is the case with fitness level which further helps in finding the heart rate.

# 6.0 Conclusion:

To sum up, there is no doubt about the physiological strain associated with the Strenuous Endurance Exercise. However, this strain can be controlled. To control the strain a person can exercise with the lighter-intensity workload. The exposure to the workload depends on the age and fitness level of the person. If these points are kept in mind while exercising daily, then the person can enjoy the perks of exercising daily (Owan et al., 1997). The benefits of exercise are greater, which include coping with stress and giving a boost to the learning activities of the person.

# References


Stewart, G., Kavanagh, J., Haseler, L., & Sabapathy, S. (2016). Reply from Glenn M. Stewart, Justin J. Kavanagh, Luke J. Haseler and Surendran Sabapathy. *The Journal Of Physiology*, *594*(11), 3159-3160. https://dx.doi.org/10.1113/jp272480

*In The Long Run, Exertion Regulation Wins The Day For Marathon Runners*. (2018). *ScienceDaily*. Retrieved 3 March 2018, from https://www.sciencedaily.com/releases/2008/08/080812213810.htm

: Owan, I., Burr, D., Turner, C., Qiu, J., Tu, Y., Onyia, J., & Duncan, R. (1997). Mechanotransduction in bone: osteoblasts are more responsive to fluid forces than mechanical strain. *American Journal Of Physiology-Cell Physiology*, *273*(3), C810-C815. https://dx.doi.org/10.1152/ajpcell.1997.273.3.c810

Esteve-Lanao, J., Lucia, A., deKoning, J., & Foster, C. (2008). How Do Humans Control Physiological Strain during Strenuous Endurance Exercise?. *Plos ONE*, *3*(8), e2943. https://dx.doi.org/10.1371/journal.pone.0002943

Sawka, M., Young, A., Latzka, W., Neufer, P., Quigley, M., & Pandolf, K. (1992). Human tolerance to heat strain during exercise: influence of hydration. *Journal Of Applied Physiology*, *73*(1), 368-375. https://dx.doi.org/10.1152/jappl.1992.73.1.368

EPSTEIN, Y., & MORAN, D. (2006). Thermal Comfort and the Heat Stress Indices. *Industrial Health*, *44*(3), 388-398. https://dx.doi.org/10.2486/indhealth.44.388

Ulmer, H. (1996). Concept of an extracellular regulation of muscular metabolic rate during heavy exercise in humans by psychophysiological feedback. *Experientia*, *52*(5), 416-420. https://dx.doi.org/10.1007/bf01919309

Caldwell, J., Engelen, L., van der Henst, C., Patterson, M., & Taylor, N. (2011). The Interaction of Body Armor, Low-Intensity Exercise, and Hot-Humid Conditions on Physiological Strain and Cognitive Function. *Military Medicine*, *176*(5), 488-493. https://dx.doi.org/10.7205/milmed-d-10-00010

: SIMS, S., van VLIET, L., COTTER, J., & REHRER, N. (2007). Sodium Loading Aids Fluid Balance and

Reduces Physiological Strain of Trained Men Exercising in the Heat. *Medicine & Science In Sports & Exercise*, *39*(1), 123-130. https://dx.doi.org/10.1249/01.mss.0000241639.97972.4a

Aliverti, A., Cala, S., Duranti, R., Ferrigno, G., Kenyon, C., & Pedotti, A. et al. (1997). Human respiratory muscle actions and control during exercise. *Journal Of Applied Physiology*, *83*(4), 1256-1269. https://dx.doi.org/10.1152/jappl.1997.83.4.1256

Nielsen, B., Hales, J., Strange, S., Christensen, N., Warberg, J., & Saltin, B. (1993). Human circulatory and thermoregulatory adaptations with heat acclimation and exercise in a hot, dry environment. *The Journal Of Physiology*, *460*(1), 467-485. https://dx.doi.org/10.1113/jphysiol.1993.sp019482