Utilizing Heart Rate as an Exercise Intensity Training Method To Determine Overtraining for Collegiate Long-Distance Runners

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Abstract

In recent years, heart rate has become easier to measure and collect data. Heart rate is a direct measurement of the autonomic nervous system. Therefore, it is utilized in aerobic training to determine an appropriate exercise intensity within a general population. Long distance runners utilize blood lactate threshold-based and maximum oxygen uptake-based speeds and paces as their exercise intensity during training. Overtraining is often determined by rate of perceived exertion by the athlete. There has yet to be an established physiological marker to indicate overtraining in collegiate long-distance runners. There are strong correlations between blood lactate threshold and VO2 with heart rate physiological markers such as percent maximal heart rate (%Hrmax) and heart rate variability (HRV). HR-based physiological markers that can be utilized to indicate overtraining are %Hrmax with intensity zones, %HRR with intensity zones, HRV, and cardiac drift. However, further studies need to be conducted to establish appropriate utilization of each physiological marker.

Introduction

The purpose of this study is to determine if heart rate physiological markers can be utilized as an exercise intensity training method to determine overtraining in collegiate long-distance runners.

Significance

The significance of this study is to help coaches and athletes understand the importance of appropriate exercise intensity for training. Having knowledge of when an athlete might be reaching a state of overtraining can give coaches and athletes an advantage to prescribing appropriate training and recovery. There are several heart rate-based methods that can be utilized to indicate overtraining. This study will help determine the appropriate training responses in each marker and therefore, provide a helpful knowledge of appropriate training.

Research Design

Objectives:

- Overtraining
- Why heart rate as a physiological marker
- Heart Rate Physiological Markers
  - Maximum Heart Rate
  - Heart Rate Reserve
  - Cardiac Drift
  - Heart Rate Variability

Proposed research questions:

1. Why is overtraining important to identify in an athlete?
2. Why is heart rate an appropriate physiological marker to use for an exercise intensity method.
3. Are there strong correlations between heart rate training methods and blood lactate threshold and maximum oxygen uptake methods?
4. Is heart rate variability a good physiological marker for overtraining?

Role of the researcher is strictly to analyze the literature related to research studies that have utilized heart rate in training in long distance running.

Key terms and definitions

Blood Lactate Threshold: Blood Lactate Threshold Definition Lactate threshold is the point during exercise of increasing intensity at which blood lactate begins to accumulate above resting levels, where lactate clearance is no longer able to keep up with lactate production (Kenney, Wilmore, & Costill, Energy Expenditure, Fatigue, and Muscle Soreness, 2020).

Maximum Oxygen Uptake (VO2max): VO2max is the maximal capacity for oxygen consumption by the body during maximal exertion (Kenney, Wilmore, & Costill, Energy Expenditure, Fatigue, and Muscle Soreness, 2020).

Heart Rate: One of the simplest physiological responses to measure and yet one of the most informative in terms of cardiovascular stress and strain. Measuring involves simply taking the subjects pules usually at the radial or carotid artery (Kenney, Wilmore, & Costill, Cardiorespiratory Responses to Acute Exercise, 2020, p. 200).

Heart Rate Reserve: Defined as the difference between HRmax and the resting heart rate (HRrest) – Maximal HRR = HRmax – HRrest (Kenney, Wilmore, & Costill, Prescription of Exercise for Health and Fitness, 2020, p. 520).

Maximum Heart Rate: This is the highest heart rate value achieved in an all-out effort to the point of volitional fatigue (Kenney, Wilmore, & Costill, Cardiorespiratory Responses to Acute Exercise, 2020, p. 200)

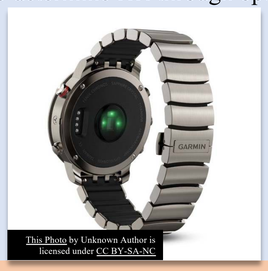
Findings

Characteristics of Overtraining:

- Working out or training at a high intensity for long periods of time throughout the day or week without following up by proper recover can lead to over-doing it.
- Overtraining can lead too low race performance, poor workout performance, lack of improvement, and injury.
- It is important to know when an athlete may be reaching overload. Therefore, a physiological marker that can identify these training states during training needs to be established (Nelson, et al., 2020).

Why Heart Rate:

- Research shows that HR-based measures provides a simple measure of the autonomic nervous system function (Bosquet, Merkari, Arvisais, & Aubert, 2008).
- Easy to measure, record, and store data (Londeree et al. 1994)
- Rider (2021) states that "Photoplethysmography (PPG) measures HR through the skin using light emitting diode (LED) lights to determine HR through optical blood flow."



Heart Rate and Blood Lactate:

Lactate threshold has been shown to be the best and most accurate predictors of endurance performance states Weltman et al. (1990)

In Perret and Hartmann's (2021) research, heart rate and blood lactate proved to have a strong correlation.

Maximum Heart Rate:

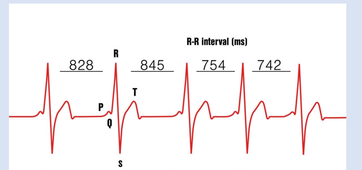
Heart rate has been known to have a correlation with endurance capacity when expressed in percent maximum heart rate (%HRmax).

Heart Rate Reserve:

According to Scheid and O'Donnell (2019) the heart rate reserve method is the most accurate way for a health and fitness professional to establish a target heart rate for a client.

Heart Rate Variability and Recovery:

- When training at an intense physical protocol the sympathetic and parasympathetic nervous systems are disrupted in their own way respectively.
- The parasympathetic seems to be disrupted as in full recovery is not taking affect, and sympathetic seems to be disrupted that full physical performance cannot be reached (Pichot et al. 2000).



Conclusion

A training intensity can be prescribed for a runner based on a certain heart rate percentages. Understanding heart rate percentage zones and the amount of time that is spent in each zone, can determine the intensity minutes an individual is performing. Too much time in the HR max zone can indicate that training intensity or volume is too high. Heart rate variability can be a great identifier for proper recovery and can help identify when an individual is training too intensely. New technologies, such as "WHOOP" bands, can help measure exercise intensity through HRV. Lastly, further studies need to be conducted to establish appropriate utilization of each physiological marker.

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