Filarecka Agnieszka, Biernacki Maciej. Resting heart rate as a determinant of fatigue -reforming- analysis of the impact of strength and strength training on the cadres curves. Journal of Education, Health and Sport. 2018;8(9):1115-1126. eISNN 2391-8306. DOI http://dx.doi.org/10.5281/zenodo.1421364
http://ojs.ukw.edu.pl/index.php/johs/article/view/6024

The journal has had 7 points in Ministry of Science and Higher Education parametric evaluation. Part b item 1223 (26/01/2017).
1223 Journal of Education, Health and Sport eISSN 2391-8306 7

The authors declare that there is no conflict of interests regarding the publication of this paper.

Received: 22.08.2018. Revised: 28.08.2018. Accepted: 15.09.2018.

Resting heart rate as a determinant of fatigue -reforming- analysis of the impact of strength and strength training on the cadres curves

Agnieszka Filarecka [1], Maciej Biernacki [2]

[1] Collegium Medicum, UMK Bydgoszcz, Chair and Clinic of Oncological Surgery

[2] Collegium Medicum, UMK Bydgoszcz, Chair and Department od Anatomy

Corresponding author:

mgr Agnieszka Filarecka

Collegium Medicum, UMK Bydgoszcz, hair and Clinic of Oncological Surgery

ul. Izabeli Romanowskiej 2, 85-796 Bydgoszcz, Poland

Tel. 503074346

e-mail: aga.filarecka@gmail.com

Abstract

Objectives. The overload occurring during the formation of motor features may be caused by insufficient regeneration of the fissures. Too intensive training can lead to reduced efficiency, but efficiency is developing on the borderline of possibilities. so you should find the moment when the player presents the first symptoms of fatigueThe aim of data analysis is to show the relationship of the pulse curve as a sign of training fatigue and the impact of changes in altitude on the adaptation of the cardiovascular system.

Material and methods. The data from the training camp of Polish senior canoeists during the climat training camp in Belmeken in Bulgaria were used for the study. Resting heart rate were investigated on solids between 6:00 am and 8:00 pm behind an assumed heart rate on the chest. Morning results were compared with the evening of the previous day.

Results. Morning and evening heart rate are indicative of fatigue,The heart rate changes with altitude.The regeneration level can be read from the intersection of the pulse line. Strength training is a more stressful training. The level of regeneration after endurance training is greater compared to strength training. 24-hour training break has a beneficial effect on regeneration, prolonged physical efforts require longer regeneration time

Conclusions. Morning and evening heart rate is a good indicator of fatigue. Monitoring of the parameter allows to avoid overtraining before other signs of fatigue can be felt. During the development of strength and endurance monitoring of the heart rate will help choose the right training and determine rest and recovery periods.

Key words: training fatigue, overtraining, resting heart rate

Introduction:

Training to create strength and endurance is an indispensable element of every sport discipline. Strength as a combination of two elements has a significant impact on the athlete's performance. Strength training is associated primarily with soreness with a long oxygen effort, but this motor feature can also be built in the anaerobic range during short intensive training [1]. In strength training, referring to endurance, the so-called strength-strength, which concerns muscle work [1,2]:

- with external resistance or own body,
- in the unit of time with the greatest tolerance of increasing fatigue.

In practice, this will mean that with greater strength and strength you can:

- perform a greater number of repetitions with the same weight;
- shorten the break between sets without compromising the quality of work.

During the preparatory phase, before the specialization phase, a very important factor is also to prevent overtraining-fatigue. In the phase of shaping the efficiency and strength, the number of training units significantly imposes the athlete's body [3]. Often, at this stage, the climatic conditions are also changed to obtain better effects of the foundation for specialist training, in which the number of training units is smaller but their intensity increases.

Strength strength allows you to do more work in a given unit of time. Due to faster rest during break. However, greater endurance will allow you to maintain intensity and volume of training without signs of fatigue and overtraining [4].

Overtraining during the construction phase of efficiency and strength causes fatigue, apathy for training, increases the chances of injury especially in the specialization phase where training loads increase [1,2]. In order to avoid fatigue, one of the methods used by athletes is the analysis of the early and evening resting heart rate. Heart rate measurements are made daily after waking up and before going to sleep. The heart rate difference can be talked about the degree of regeneration. When the pulse curves cross, it is a signal that is too short after the training day. Heart rate differences can also be observed in the acclimatization phase, especially when it involves changing altitude above sea level [3-6].

Resting heart rate in a healthy person varies from 60 to 80 beats per minute. This factor can be examined from a surface vein, located on the neck or forearm. Relaxed heart rate depends on several variable factors. Too high resting heart rate may indicate changes in the body [1].

he pulse is called arterial movement, which depends on the contractions of our heart, but also depends on the thickness of the arterial walls [7]. The resting heart rate is the heartbeat, which should be examined after about 10 minutes of rest, and it is best to examine them after waking up [5-7]. Resting muscles can be measured in several ways, firstly they can be sensed from the main arteries, located on the wrist, neck or thigh. Secondly, special devices are used to measure the resting heart rate - pulse oximeters, heart rate monitors. The third way to measure your resting heart rate is to use an electronic blood pressure monitor. Measurement of the resting heart rate is the number of artery vibrations that will occur during the minute measurement - compression of the artery [8].

The correct resting heart rate depends on many factors. One of them is the age of the examined person, and training. Resting heart rate may be too high, but also too low. If the measured resting heart rate is much higher than a given norm, then it may be a symptom of tachycardia, or too rapid heartbeat caused by illness or stress.

In addition to tachycardia, the higher heart rate is in people who [1-3, 7–10]:

- they consume a lot of caffeine;
- they are obese;
- they are overly stressed;
- they have hormonal disorders;
- they have a high fever.

The resting heart curve measured daily after waking up and before going to bed illustrates the degree of recovery after the training day [9]. The heart rate measured at rest in the evening compared to the morning pulse of the next day can be used as an indicator of fatigue [10]. If the morning resting heart rate is higher or equal to the pulse rate, this means the first signs of fatigue. Athlete fatigue may not yet be visible in performing training tasks, however, build-up training units will have an effect on extending regeneration time in order to avoid an exhaustion syndrome [8,9]. The overtraining occurring in the preparation phase of the competitors is an unfavorable factor affecting the development of motor features in the specialist phase.

Materials and methods

The work uses data from a group of Polish senior canoeists during the climatic grouping. The purpose of the data analysis is to show the relationship between the morning and protiening resting

heart rate curve as a sign of training fatigue and the impact of changes in altitude on the adaptation of the stinging system. During a climatic group lasting 3 weeks (21 days), competitors were measured every morning by measuring their resting heart rate with a heart rate monitor pulse on the chest.

Ryc. 1. *Position of the heart rate monitor on the chest*

The results of the morning heart rate were compared to the evening results in order to observe the degree of regeneration of the body after the training day. The measurements were taken at a constant time of 6:00 am and 8:00 pm in order to eliminate the measurement error.

From the collected data curves were created, which illustrate fluctuations in the wounded and evening heart rate depending on the day and type of training.

The training schedule was as follows:

- Monday - skiing, strength training
- Tuesday - skiing, circuit trening
- Wednesday - skiing, functional trening
- Thursday - swimming, rest day
- Friday - skiing, strength training
- Saturday - skiing, circuit trening
- Sunday - Rest Day

The data collected each day are as follows:

Figure.1. *One-off intersection of the pulse curves suggesting fatigue associated with the duration of the grouping*

Figure .2. *Repeated fluctuations in the second half of the training cyc*

Figure. 3. *Approaching the pulse curves in the last phase of the grouping*

Figure. 4. *Approaching the pulse curves after each strength training*

Figure. 5. Visible fatigue effect with grouping, morning curve higher than evening

Figure. 6. *Visible acclimation in the first phase of the morning heart rate*

Figure.7. *Visible acclimatization in the first phase of morning flutter higher than the evening*

Figure. 8. *Maintaining the level of regeneration in most of the time of the grouping*

The presented results show wound and evening pulse curves that intersect. Crossing the morning and evening lines or approaching these lines informs about too short regeneration of the player. This information is necessary to motivate training. Among the collected data are visible changes in the resting heart rate associated with the adaptation of players associated with the height of 2000m.

The collected data suggest that each player requires individual observation of regeneration and adjustment of training to the level of fatigue.

In one of the players, the heart rate lines did not intersect during the entire training period . In other cases, the lines crossed at least once.

Results

- Morning and evening heart rate are indicative of fatigue
- The heart rate changes with altitude
- The regeneration level can be read from the intersection of the pulse line
- Strength training is more stressful training
- The level of regeneration after endurance training is greater compared to strength training
- 24-hour training break has a beneficial effect on regeneration, prolonged physical efforts require longer regeneration.
- Competitors do not regenerate the same
- Training should be selected individually
- During training plan should be paid to the level of regeneration

Discussion

Contrary to popular belief, exhaustion is not synonymous with overtraining. According to researchers, fatigue can be divided into two types - functional (FOR, Functional Overreaching) and non-functional (NFOR, Non-Functional Overreaching). We speak of functional exhaustion when the player experiences a short-term decline in the form without psychological symptoms and other types of symptoms. Very often, runners struggle with this phenomenon after training loads on running camps. Although initially the form may fall, functional exhaustion is positive - it usually leads to super-compensation, or form improvement [11,12,13]

The results obtained can be inferred that in the case of training should be approached individually to the possibilities of regenerative player. in the available literature there is no indication of the time needed for regeneration [14,15,16,17]. According to reports, the main reason for the occurrence of injuries is overload [11,13,14]. Overloads arise in the mechanism of loss of motor control [10]. Excessive strain on training units is conducive to overloading [12,14,15,18]. The problem is the distinction between non-functional fatigue and overtraining, and it is not easy to set a boundary. In

fact, it is difficult to distinguish between fatigue and overtraining, because the symptoms are similar [17,18,19,20]. The OTS, Overtraining Syndrome may be indicative of too long adaptation period for the player. It is assumed that symptoms characteristic of overtraining such as: lack of form, mood swings and excessive fatigue are similar to fatigue. If the player is overtrained, it takes much longer to get back to the state before [12,13,15,18]

Conclusion

Resting sleep morning and evening is a good indicator of fatigue. Parameter monitoring allows you to avoid the overtraining effect before you experience other signs of fatigue. While shaping strength and endurance, heart rate monitoring will allow you to choose the right workout, and also determine the moment of rest and regeneration. In each training phase, tetno is one of the determinants of fatigue and in the rest phase determines the level of regeneration. From the results presented, it can be concluded that not all athletes recover in the same way despite participating in the same training. when planning a workout, pay attention to the level of regeneration and adjust the training so that it does not load too much. The player's overtraining causes a decrease in all motor features, which results in a worsening of the results.

References

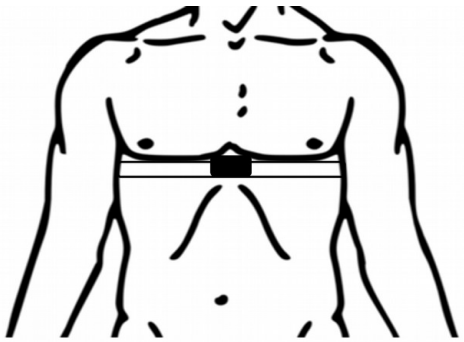
1. Górski J.[Physiology of effort and physical training]. Warszawa: PZWL;2011. Polish
2. Górski J.[Physiological basis of physical exercise]. Warszawa: PZWL; 2006. Polish
3. Ronkier A. [Physiology of effort in sport, physiotherapy and recreation]. Warszawa: COS; 2008. Polish
4. Hubner-Woźniak E., Lutosławska G. [Basics of biochemistry of physical exercise]. Warszawa: COS; 2008. Polish
5. Jaskólska A., Jaskólski A, [Basics of physiology of physical exertion with the outline of human physiology]. Wroclaw:Urban & Partner; 2005. Polish
6. Czarkowska-Pączek B., Przybylski J. [Outline of the physiology of physical exertion] Wroclaw: Elsevier Urban & Partner; 2006 . Polish
7. Fortuna M. [Basics of shaping aerobic and anaerobic exercise capacity]. Jelenia Gora: Publisher Kolegium Karkonoskie; 2012. Polish

8. Booth F.W., Chakravarthy M.V., Spangenburg E.E., Exercise and gene expression: physiological regulation of the human genome through physical activity. J Physiol, vol. 543, nr 2, 399-411, 2002
9. Kozłowski S., Nazar K. [Introduction to clinical physiology]. Warszawa: Medical Publisher PZWL; 1995. Polish
10. Dziak A., Nazar K. [Sports medicine]. Warszawa: Medical Publisher PZWL; 2002
11. Byrne, C. & Eston, R. The effect of exercise-induced muscle damage on isometric and dynamic knee extensor strength and vertical jump performance. *Journal of Sports Sciences 2002*. 20: 417- 425.
12. Coutts, A., Reaburn, P., Piva, T., & Murphy, A. Changes in selected biochemical, muscular strength, power, and endurance measures during deliberate overreaching and tapering in rugby league players. *International Journal of Sports Medicine*. 2007. 28: 116-124.
13. Faude, O., Meyer, T., Urhausen, A., & Kindermann, W. Recovery training in cyclists: ergometric, hormonal and psychometric findings. *Scandinavian Journal of Medicine and Science in Sports* 2009. 19: 433-441.
14. Montgomery, P., Pyne, D., Cox, A., Hopkins, W., Minahan, C., & Hunt, P. Muscle damage, inflammation, and recovery interventions during a 3-day basketball tournament. *European Journal of Sport Science 2*008. 8: 241-250.
15. Nosaka, K., Abbiss, C., Watson, G., Wall, B., Suzuki, K., & Laursen, P. Recovery following an Ironman triathlon: A case study. *European Journal of Sport Science* 2010. 10: 169-165.
16. Robson-Ansley, P., Gleeson, M., & Ansley, L. Fatigue management in the preparation of Olympic athletes. *Journal of Sports Sciences* 2009. 27: 1409-1420.
17. Nindl, B., Leone, C., Tharion, W., Johnson, R., Castellani, J., Patton, J., & Montain, S. Physical performance responses to 72 h of military operational stress. *Medicine and Science in Sports and Exercis*e 2002. 34: 1814-1822.

18. Lamberts, R. & Lambert, M. Day-to-day variation in heart rate at different levels of submaximal exertion: implications for monitoring training. Journal of Strength and Conditioning Research:1005-1010. 2009.

19. Kellman, M. & Gunther, K. Changes in stress and recovery in elite rowers during preparation for the Olympic games. *Medicine and Science in Sports and Exercise* 2000. 32: 676-683. 2000

20. Halson, S. & Jeukendrup, A. Does overtraining exist? An analysis of overreaching and overtraining research. *Sports Medicin*e 2004.. 34: 967-981.



Ryc. 1. *Position of the heart rate monitor on the chest*

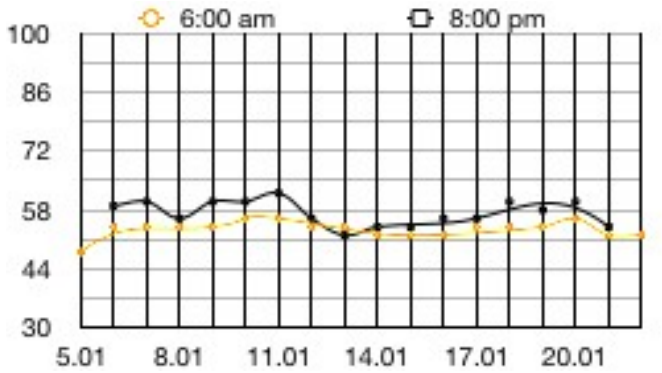


Figure.1. *One-off intersection of the pulse curves suggesting fatigue associated with the duration of the grouping*

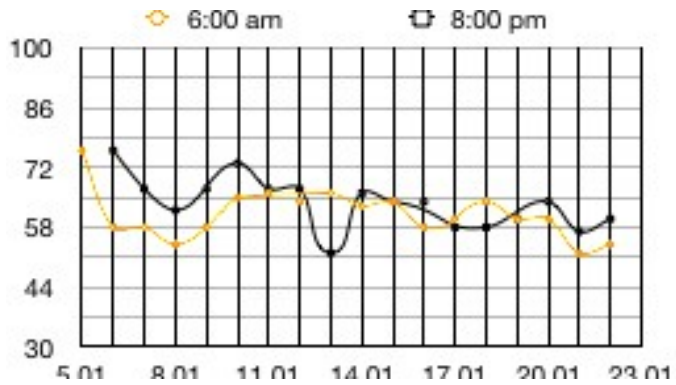


Figure. 2. *Repeated fluctuations in the second half of the training cyc*

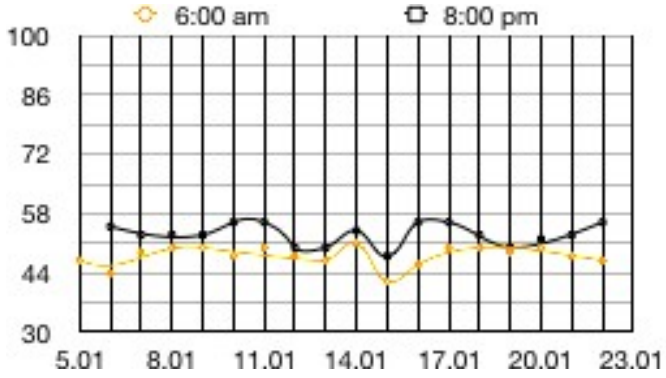


Figure. 3. *Approaching the pulse curves in the last phase of the grouping*

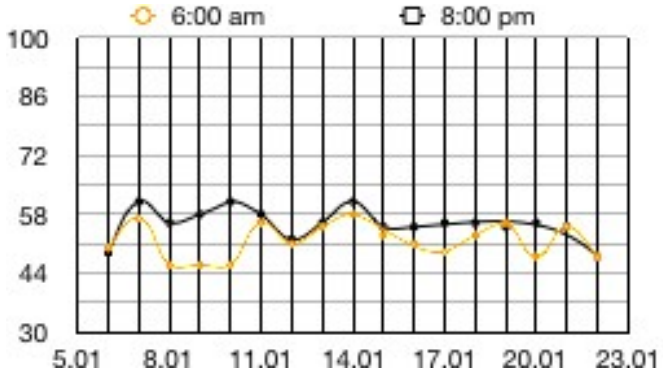


Figure 4. *Approaching the pulse curves after each strength training*

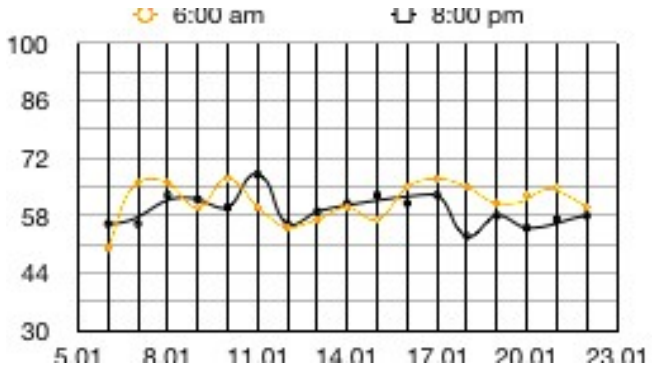


Figure 5. *Visible fatigue effect with grouping, morning curve higher than evening*

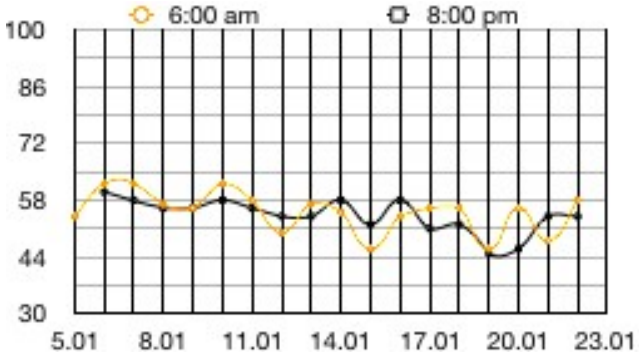


Figure 6. V*isible acclimation in the first phase of the morning heart rate*

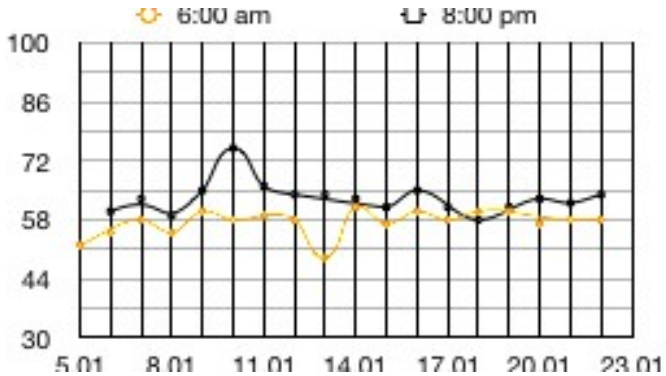


Figure. 7. *Visible acclimatization in the first phase of morning flutter higher than the evening*

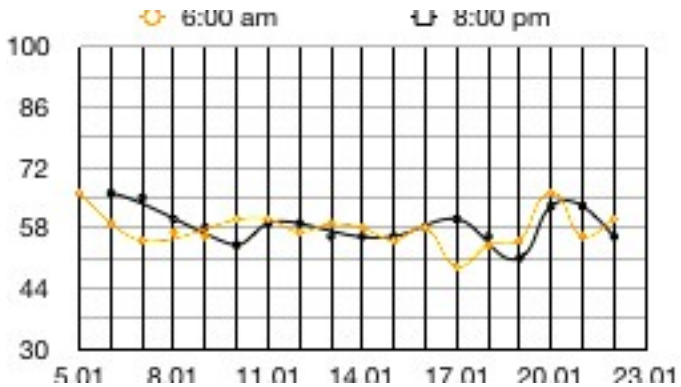


Figure. 8.*Maintaining the level of regeneration in most of the time of the grouping*