75 - RELATIONSHIP BETWEEN TRAINING INTENSITY AND HEART RATE IN SWIMMING ATHLETES

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Introduction

Athletes who aim at the high level of performance need several years of planned, methodical and arduous training to get the body adaptation favorable to the Chosen sport (Bompa, 2002). Adaptation occurs when the athlete carries out stimuli that generate stress to the body, originated by the response to the training. According to Powers and Howley (2009), stress is caused by the overload. The athlete should carry out greater stimuli than he is accustomed to improving performance.

To obtain adequate overload, both volume and intensity stimuli, the training phase in which the athlete is to be. Bompa (2002) highlights that, because they are interdependent, the alternation between them should occur, if this alternation is not properly applied, the athlete may be harmed.

When the exercise is practiced in intensity and high volume, it is imperative to use appropriate parameters in the measurement of the intensity of effort, expended for a given task, as the athlete performs the training for a period, ends up acquiring. Better performance and the training load should be adjusted.

To continue having evolution in the mode, Bompa (2002); Powers and Howley (2009) and Maglischo (2010) highlight that the load progression gradually increases because, because of the training, the efficiency of the organism and the capacity for performing work is gradually increasing, and only with this accumulation of work, the athlete will get a performance improvement. If this load progression is not efficient, the athlete may stagnate, or the performance regression may even occur.

Among the parameters to monitor the control intensity of training, the heart rate (heart rate), oxygen consumption (VO2), the subjective perception of the effort (SPE) and the ventilatory and lactate thresholds (Graef and Kruel, 2006). Among the parameters to monitor the control intensity of training, the heart rate (heart rate), oxygen consumption (VO2), the subjective perception of the effort (SPE) and the ventilatory and lactate thresholds (Graef and Kruel, 2006). Although it is indispensable to use these to measure the intensity of training, Bompa (2002) highlights that many technicians still use the subjectivity in trainings, thus, they end up overcharging their athletes, especially in the next period as major competitions.

The author McArdle et al (2013), highlights that the VO2 is one of the best parameters to quantify cardiovascular functional capacity and aerobic fitness of the individual, but this method requires specialized equipment for the achievement of it, so it ends up being little used for a large group of people. In contrast, heart rate is one of the most commonly used variables in controlling the intensity of the effort, both for its convenience and ease of control. For coaches, this is a great option, because heart rate is a cheap, affordable, non-evasive instrument and widely accepted as the easiest physiological orientation of the individual's cardiovascular condition (Colwin, 2000). However, Maglischo (2010) highlights that care should be taken when using it, because they are subject to the influences of the training, thereby taking the wrong interpretations.

Forteza de La Rosa (2009) suggests the use of heart rate as a method to assist, detect and control the intensity of a training program. The authors Foss and Keteyian (2000) and McArdle et al (2013) Also recommend it, as they highlight that heart rate has a relationship with the VO2, regardless of gender, race, fitness level, exercise mode or age.

According to Maglischo (2010) All athletes should meet their maximum heart rate, as it is possible to accurately determine the training loads performed for a certain exercise, for this is recommended the use of heart rate monitoring apparatus, but the author highlights That individuals can count their heart rate via pulse at radial artery or carotid artery level. McArdle et al (2013) highlights that palpation of the pulse at the radial artery level is more appropriate, as even with vigorous palpation does not affect the measurement of heart rate.

Swimming for being an aquatic sport, must be analyzed differently from terrestrial sports, because according to Graef and Kruel (2006) activities when carried out in aquatic environment have distinct specificities of the terrestrial environment such as: immersion volume, body position and water temperature, these influencing the stress intensity indicators. Because of these variations Graef and Kruel (2006); Bastos el Al (2007) and Maglischo (2010) concluded in his studies that heart rate, in this medium, shows significantly reduced, compared to the terrestrial medium. Such authors emphasize that this difference should be considered at the time of the prescription of exercises in aquatic environment, as they may influence the time of the proposed activity, leading to the trainers to make mistakes.

There are variables to try to justify this decrease in heart rate in the aquatic environment, according to Graef and Kruel (2006) and Maglischo (2010), due to the largest volume systolic caused by the body position of decubitus, which causes the heart not to work so much to carry Blood to the limbs, and due to the water temperature, in environments intended for the practice of aquatic activity, the cooling of the water reduces body temperature and decreases dehydration thus reduces the tension that occurs in the circulatory system.

Other factors cited by the authors Graef and Kruel (2006) that can justify the decrease in heart rate are: decreased sympathetic nerve activity caused to "potentiate the responses to bradycardia in immersion"; and by reducing hydrostatic weight, due to the lowest recruitment of muscles. As there are these variables, when applying to heart rate as a training intensity parameter, we should take them into consideration at the time of the exercise.

Therefore, the present study aims to correlate the heart rate with the intensity of training, measured through the Cooper Test (1982) for the swimming mode.

Methodology

This research was characterized as a field, of character applied, with the realization of tests whose data were analyzed quantitatively through physical and statistical evaluation.

The survey involved 11 athletes of the São Bento Swim Club in the municipality of São Bento do Sul-SC of both sexes, aged between 14 and 18 years, competing in swimming mode for at least a year and not ingesting any medication with β-blockers. The participants signed the free and enlightened compromise term, along with their responsible for under 18 years of age. This study was approved by the Ethics Committee on the protocol CAAE n º 38887014.9.0000.5366. They also filled out a questionnaire with personal questions pertinent to the research.

The sample was characterized from the data anthropometric collected, among them the body mass and stature. It was presented to participants as the tests were conducted as well as goals, benefits and possible risks. This way the collection was considered active, interactive and participatory among researchers and research, aiming to establish a clearer understanding of the relevant aspects of the research.

Data collections were carried out in a 25m pool with water temperature at 30º C. The tests were conducted in the afternoon period, when the athletes performed their training.

It was assessed the resting heart rate of the radial pulse during the 15-second period and the participants were asked to carry out a heating of 500 meters.

The Cooper Test (1982) was used, with a duration of 12 minutes, at the maximum speed of the swimmer in the swim crawl, that set to 100% of its maximum capacity for this test. For those to know how they were performing the test, they were asked to tell the footage they were performing and was sounded a brief whistle at six minutes and a long whistle at the end of the test.

After the completion of the test, the heart rate of each athlete was verified and noted in an individual way the distance traveled.

After a week the test was again applied, but a speed of 85% of its maximum capacity was used. The same initial conditions for the collection of 100% of the maximum capacity were adopted.

The collected data was tabulated in a database in the Excel for Windows worksheet and then used the descriptive statistic with central trend measures (average) and dispersion (standard deviation). The Shapiro Wilk test demonstrated normality among the variables investigated, thereby opting for parametric tests. The sampling of the samples was given by the Post-Hoc test of Tukey for dependent samples, adopting a significance level $p < 0.05$.

Analysis and Discussion of Results

They were part of this study 11 athletes of the swimming mode, being eight women and three men who possessed average practice time of 4.6 ± 1.7 years, with average age 14.7 ± 1.3 years, body mass of 58.6 ± 8.0 Kg, stature of 166.3 ± 6.6 cm, corporeal mass index of 21.2 ± 2,6 kg/m². The results obtained with the sample demonstrated that the survey participants have homogeneous characteristics among themselves.

By analyzing the distances traveled by the athletes, we verified that in the test at 100%, were 875.5 ± 72.7 meters and that, in the test to 85%, the athletes traveled 848.0 ± 67.7 meters. Compared to the results obtained with the suggested results by Cooper (1982), we verified that all attained higher distances considered as excellent by the author, even performing the test at 85%, that is, results higher than 731 meters for men and more than 639 meters for women, and all athletes have attained distances exceeding those considered excellent for both sexes.

To evaluate the heart rate results obtained with the tests, we use the Karvonen formula (220-age) and subtracted 17bpm, heart rate decreases in the aquatic environment found by Nogueira et al (2002).

Table 1. Difference between the heart rate obtained and predicted in swimming athletes (n = 11) aged between 14 and 18 years, subjected to maximum test and submaximal training.

	n	obtained Ẋ±SD	previous Ẋ±SD	Δ%	p
heart rate máx bpm	11	177.1±15.3	188.3±1.3	11.2 (5.9%)	0.04
heart rate sub máx bpm	11	155.3±16.8	150.5±13.0	-4.7(-3.2%)	0.44

relative difference, *p= post-Hoc de Tukey test*, being α 0,05

When we compared the calculation presented in this study, heart rate Max = (220-age) – 17, with the calculation advised by Nogueira et al (2002), Maximum heart rate = 204 – 1.07 * age, as the most indicated to estimate the maximum heart rate in swimming, we can notice similarities between the results, so both can be used for such a water environment. Table 1 shows that the investigated population obtained maximum heart rate average of 177.1 ± 15.3 bpm, compared to the predicted heart rate: 188.3 ± 1.3 bpm, there was a difference of 5.9% ($p< 0.04$), that is the athletes did not perform the test to 100% of their capacities, such a fact may have occurred by the degree of motivation of the athletes during the test (Junior et al., 2010).

Junior et al (2010) observed maximum heart rate behavior in fasting and not fasting in swimming practitioners through Cooper's test, found heart rate posttest of 138.2 BPM fasting and 137.3 bpm on not fasting. Bastos et al (2007) analyzed the heart rate behavior of active individuals subjected to the test of maximum VO2 in two distinct environments and found heart rate posttest of 165.33 ± 11, 55bpm in aquatic environment. Both authors found results inferior to those of this study.

Already in the studies of Gomes et al (2003), which compared the two-speed test and the T30 test to identify the best speed indicated in the prescription of the unentrenched training of short and long distances in youth category swimming athletes, found results of heart rate maximum of 175 ± 14 BPM for men and 175 ± 15 for women in the test T30 and 188 ± 8 for men and 185 ± 9 for women in the 2-speed test (result to 100%). Compared with the results of this study, the T30 test obtained similar results with heart rate obtained and with the 2-speed test (result to 100%), the results were like heart rate predicted.

In the tests conducted by Nogueira et al (2002), which were intended to identify whether there is significant difference between the maximum heart rate obtained during swimming exercises in three distances (100, 150 and 200 meters), compared with the heart rate Calculated maximum estimated by 21 equations, the authors found the following results of heart rate Maximum: 178 ± 3.5 BPM for the distance of 100m, 179.5 ± 4.8 bpm for distance of 150m and 180.3 ± 3.2 bpm for distance from 200m. Analyzing the study, the heart rate Max obtained by the authors, were similar to the values obtained for the present study, even the distances traveled are not the same between the tests.

When athletes underwent Cooper test (1982) at 85%, the result of heart rate Submaxim was 155.3 ± 16.8 bpm. In comparison with the predicted result, 150.5 ± 13.0, a difference of-3.2% (P 0.44) was found, showing that the athletes performed the test within what was requested.

In the test conducted by Gomes et al (2003), the results found of heart rate Sub máx were of: 182 ± 11 for men and 180 ± 11, but at the distance of 400 meters in the two-speed test, such study found heart rate superior to those found in this study Both the maximum test and the maximum test.

Based on the research question, which focused on checking whether the use of the heart rate associated with the

Cooper Test (1982) is an effective method of monitoring the intensity of training in competitive swimming athletes, it can be concluded that heart rate has suffered decrease in Aquatic environment, such decrease was also found by Bastos et al (2007), Gomes et al (2003), Graef and Kruel (2006), Junior et al (2010) and Nogueira et al (2002). This reduction, when not properly observed, can cause the athlete to perform inappropriate stimuli.

It was noted that athletes when subjected to the Cooper Test (1982) to 100%, did not reach the maximum heart rate predicted, but managed to perform the test at 85% within what was requested. According to Maglischo (2010) so that the maximum heart rate is the real athlete, the same should be assessed during or immediately after several maximum efforts, which have minimum duration of 1 to 2 minutes, only one verification may not be the actual maximum of the swimmer.

Conclusion

The Cooper Test (1982) when used in athletes, and non-athletes presents significant differences of heart rate maximum values. This fact can be verified by compared to the present study with the results of Junior et al (2010), in which the sample was composed of swimmers, but not athletes.

With this work, whose study focuses correlating the heart rate with the intensity of training, measured through the Cooper Test (1982) for the swimming mode, we conclude that the use of heart rate associated with the Cooper Test (1982) is an Effective training intensity monitoring method in competitive swimming athletes. However, these should be evaluated individually in relation to their maximum heart rate, because, to achieve the real value, the athlete must carry out various stimuli to meet her, in addition to needing motivation to carry out the test at the requested speed.

We came to such results from the comparison between the real value obtained in the test and the expected value for the realization of the test, for this was used the formula of Karvonen (220-age) and subtracted the value of decrease in the heart rate found by Nogueira et al (2002) – 17bpm.

Although we obtain significant results from this study, it is recommended that heart rate behavior is verified in applications of Cooper Test (1982) in different intensities of the present study, through heart rate monitors, as these will result in More precise measurements of heart rate, besides being able to verify the behavior of the same during the achievement of the swimming, and that, if possible, blood tests are conducted, as physiological markers recommended by authors such as Maglischo (2010) to investigate with greater precision training intensity of athletes.

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Relationship Between Training Intensity and Heart Rate in Swimming Athletes

Abstract: Swimming for being an aquatic sport, should be analyzed differently from terrestrial sports, as activities carried out in aquatic environment have distinct specificities of the terrestrial environment. Among these variations is the decreased heart rate in this medium. The objective of this study was to correlate the heart rate with the intensity of training, measured through the Cooper test for the swimming mode. They participated in the study 11 athletes of both sexes, aged from 14 to 18 years athletes, who competed in swimming mode for at least a year and did not ingest any medications with β-blockers. The two stages of Cooper's test were carried out in a 25-metres pool with water temperature at 30 º C and the heart rate was measured before and post-test. The collected data was tabulated in a database in Excel for Windows spreadsheet and then the descriptive statistic was used with central trend measures (average) and dispersion (standard deviation). The Shapiro Wilk test demonstrated normality among the variables investigated, thereby opting for parametric tests. The sampling of the specimens was given by the Post-Hoc test of Tukey for dependent samples, adopting significance level $p < 0.05$. As a result, we can observe that the maximum heart rate obtained has not obtained similar results with the maximum predicted heart rate and that the maximum getting heart rate was like the submaximal heart rate predicted. It can be concluded that the use of heart rate associated with the Cooper test is an effective method of monitoring training intensity in competitive swimming athletes, however athletes should be assessed individually about their maximum heart rate as they are. To achieve the real value, the athlete must

carry out various stimuli to know the same, in addition to needing motivation to carry out the test at the requested speed.
Key words: Swim, training, Heart rate, Cooper Test.

Rapport d'Intensité d'Entraînement et la Fréquence Cardiaque Chez les Athlètes de Natation

Resume: Nager pour être un sport aquatique, doit être analysé différemment des sports terrestres, car les activités menées dans le milieu aquatique ont des spécificités distinctes de l'environnement terrestre. Parmi ces variations, la fréquence cardiaque diminue au milieu. L'objectif de cette étude était de corréler la fréquence cardiaque avec l'intensité de la formation, mesurée à travers le test de Cooper pour le mode de natation. Ils ont participé à l'étude 11 athlètes des deux sexes, âgés de 14 à 18 ans athlètes, qui ont participé en mode de natation pendant au moins un an et n'a pas ingéré de médicaments avec des β-bloquants. Les deux étapes de l'essai de Cooper ont été effectuées dans une piscine de 25 mètres avec la température de l'eau à 30 ºC et la fréquence cardiaque a été mesurée avant et après le test. Les données collectées ont été compilées dans une base de données dans la feuille de calcul Excel pour Windows, puis la statistique descriptive a été utilisée avec les mesures de tendance centrales (moyenne) et la dispersion (écart-type). Le test de Shapiro Wilk a démontré la normalité parmi les variables étudiées, optant ainsi pour des tests paramétriques. L'échantillonnage des échantillons a été donné par l'essai ponctuel de Tukey pour les échantillons dépendants, en adoptant un niveau de signification p < 0,05. En conséquence, nous pouvons observer que la fréquence cardiaque maximale obtenue n'a pas obtenu de résultats similaires avec la fréquence cardiaque maximale prédite et que la fréquence cardiaque maximale obtenue était semblable à la fréquence cardiaque submaximique prédite. On peut conclure que l'utilisation du FC associée au test Cooper est une méthode efficace de surveillance de l'intensité de la formation chez les athlètes de natation compétitifs, mais les athlètes devraient être évalués individuellement en ce qui concerne leur maximum FC comme ils sont. Afin d'atteindre la valeur réelle, l'athlète doit effectuer divers stimuli pour connaître la même chose, en plus d'avoir besoin de motivation pour effectuer le test à la vitesse demandée.
Mots-clés: Natation, Formation, Fréquence Cardiaque, Test de Cooper

Relación Entre la Intensidad del Entrenamiento y el Ritmo Cardíaco en los Atletas de Natación

Resumen: La natación por ser un deporte acuático, debe ser analizada de forma diferente a los deportes terrestres, ya que las actividades desarrolladas en el medio acuático tienen distintas especificidades del entorno terrestre. Entre estas variaciones, el ritmo cardíaco está declinando en el medio. El objetivo de este estudio fue correlacionar el ritmo cardíaco con la intensidad del entrenamiento, medido a través de la prueba de Cooper para el modo de natación. Participaron en el estudio 11 atletas de ambos sexos, de 14 a 18 años atletas, que compitieron en modalidad de natación durante al menos un año y no ingirieron ningún medicamento con bloqueadores β. Las dos etapas de la prueba de Cooper se realizaron en una piscina de 25 metros con temperatura del agua a 30 º C y la frecuencia cardiaca se midió antes y después de la prueba. Los datos recopilados se tabularon en una base de datos en la hoja de cálculo de Excel para Windows y, a continuación, se utilizó la estadística descriptiva con medidas de tendencia central (promedio) y dispersión (desviación estándar). La prueba de Shapiro Wilk demostró la normalidad entre las variables investigadas, de tal modo optando por pruebas paramétricas. El muestreo de las muestras fue dado por la prueba post-hoc de Tukey para muestras dependientes, adoptando un nivel de significancia p < 0,05. Como resultado podemos observar que la frecuencia cardíaca máxima obtenida no ha obtenido resultados similares con la frecuencia cardíaca máxima pronosticada y que la frecuencia cardíaca obtenida máxima fue similar a la frecuencia cardíaca submáxima pronosticada. Se puede concluir que el uso de FC asociado con la prueba de Cooper es un método eficaz de monitoreo de la intensidad de entrenamiento en atletas de natación competitivos, sin embargo, los atletas deben ser evaluados individualmente en cuanto a su FC máximo como son. Para lograr el valor real, el deportista debe llevar a cabo diversos estímulos para conocer el mismo, además de necesitar motivación para realizar la prueba a la velocidad requerida.
Palabras Claves: Natación, Entrenamiento, Frecuencia cardiaca, Prueba de Cooper

RELAÇÃO ENTRE A INTENSIDADE DE TREINAMENTO E A FREQUÊNCIA CARDÍACA EM ATLETAS DE NATAÇÃO

Resumo: A natação por ser um esporte aquático, deve ser analisada de forma diferente dos esportes terrestres, pois atividades realizadas em meio aquático possuem especificidades distintas do meio terrestre. Dentre essas variações encontra-se a frequência cardíaca que sofre diminuição nesse meio. O objetivo desse estudo foi correlacionar a frequência cardíaca com a intensidade de treinamento, mensuradas através do Teste de Cooper para a modalidade de natação. Participaram do estudo 11 atletas de ambos os sexos, com idade entre 14 a 18 anos atletas, que competiam na modalidade de natação há pelo menos um ano e que não ingerissem nenhuma medicação com β-bloqueadores. As duas etapas do teste de Cooper foram realizadas em uma piscina de 25 metros com temperatura da água em 30ºC e a frequência cardíaca foi aferida antes e pós teste. Os dados coletados foram tabulados em um banco de dados na planilha Excel for Windows e depois foi utilizada a estatística descritiva com medidas de tendência central (média) e dispersão (desvio padrão). O teste Shapiro Wilk demonstrou normalidade entre as variáveis investigadas, optando-se assim pelos testes paramétricos. O comparativo das amostras se deu pelo Teste Post-Hoc de Tukey para amostras dependentes, adotando nível de significância p<0,05. Como resultado podemos observar que a frequência cardíaca máxima obtida não obteve resultados similares com a frequência cardíaca máxima prevista e que a frequência cardíaca submáxima obtida foi similar a frequência cardíaca submáxima prevista. Pode-se concluir que a utilização da FC associada ao Teste de Cooper é um método eficaz de monitoramento de intensidade do treinamento em atletas competitivos de natação, no entanto os atletas deverão ser avaliados de forma individual no que se refere a sua FC máxima pois, para conseguir o valor real, o atleta deverá realizar vários estímulos para conhecer a mesma, além de precisar de motivação para realizar o Teste na velocidade solicitada.
Palavras Chaves: Natação, Treinamento, Frequência cardíaca, Teste de Cooper

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