43 - RELATIONSHIP BETWEEN METHODS OF MEASUREMENT OF TRAINING LOADSESSION IN A JIU-JISTU COMBAT

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INTRODUCTION

The process of physical training is most often described by the external load training, which is idealized by the coach, and physical tests are used to evaluate the training results. However, the stimulus that induces adaptations is the physiological stress imposed on the body of the individual, ie, the internal training load (IMPELLIZZERI et al., 2004). Although the external training load is one of the major factors for the quantification of internal training load, other factors such as level of pre-training conditioning and genetics significantly influence the response to training. Therefore, having a measure of internal training load has fundamental importance in monitoring and controlling the process of physical training (IMPELLIZZERI et al., 2005).

Among the methods suggested for the quantification of internal training load, the ones that are based on the behavior of heart rate (HR) are highlighted (BANISTER et al. 1999; EDWARDS, 1993, IWASAKI et al., 2003) during the exercise session. Such methods are based on the integrated analysis of the exercise time in different intensity categories defined according to individual physiological responses. To each category, an arbitrary coefficient adjustment is then assigned in order to give greater weight to training sessions at a higher intensity (TAHA; THOMAS, 2003).

Despite its applicability, the method based on HR, according to Foster et al. (2001), presents some limitations. First, despite the availability of monitors capable of integrating the HR response to exercise for long periods, its use is restricted due to economic factors. Moreover, any technical problems presented by the monitor could compromise the information obtained in the session. In combat sports such as judo and brazilian jiu-jitsu, for example, the use of the monitor may pose a risk to the physical integrity of the practitioner and possibly damage the equipment (SERRANO et al., 2001).

Seeking an alternative method to overcome the adversities mentioned, Foster et al. (1996) suggested the possibility of using the perceived exertion of the session (PES) over to HR for the quantification of internal training load. In a subsequent study, Foster et al. (2001) evaluated 26 athletes during the cycling and basketball sessions and found high correlations between the training load methods based on PES and HR, suggesting that the first applies to the determination of training load in different sports.

In the context of the martial arts, some research has been conducted in order to compare the results of the quantification of internal training load between PES and physiological parameters. In this sense, Serrano and colleagues (2001) studied the relationship between PES and blood lactate concentration in 13 judo athletes during an official championship. The results showed a significant correlation between PES and maximum concentration of blood lactate obtained minutes after the last fight.

Like judo, mentioned in the above research, jiu-jitsu is a form of martial art that is characterized as a combat sport, which has competitions at international level with principles similar to judo championships. However, there are few studies that had as its object of study, the combat sports and have researched the relationship between different forms of quantification of internal training load, with no reports of research conducted with jiu-jitsu. Thus, this research aimed to analyze the relationship between training load values determined by methods based on PES and HR in a session of jiu-jitsu combat.

METHOD

Participants: using non-probability convenience sample, five brazilian male jiu-jitsu athletes, aged 18 to 27 years, have participated in this study as volunteers. The athletes trained jiu-jitsu regularly at least for two years, with a minimum frequency of three times per week. The objectives, procedures and risks involved in the testing were first presented to them, and they signed a consent form agreeing to participate in such research. The research project was submitted and approved (protocol 112/07) by the Ethics in Research of Universidade Estadual de Santa Cruz in accordance with Resolution 196/96 of the National Health Council. The following exclusion criteria was adopted: reported use of illicit ergogenic resource, use of drugs known to affect the perception of effort and / or heart rate during exercise, and the existence or occurrence of injuries or other illnesses during the trial period.

Experimental Procedures: Volunteers were subjected to two stages of evaluation, namely: 1) anthropometric measurements, history taking and assessment of maximal heart rate (MHR), and 2) sessions of jiu-jitsu combat. Both phases had an interval minimum of 48 hours. Participants were instructed not to perform intense exercise or ingesting alcohol 24 hours before testing. Moreover, they were instructed not to consume foods and caffeinated drinks in three hours before the tests.

Anthropometric Evaluation: body mass was determined by a balance (Welmy) with a precision of 100g, while the height was measured using a stadiometer with 0.1cm accuracy. The percentage of body fat estimated from skinfolds was done by the generalized equation of Pollock (MARTINS, 2003), measured three times at each point on a rotating basis, with a brand CESCORF caliper with 0.1mm accuracy (scientific model).

Determination of MHR: It was adopted protocol adapted from Mortimer et. al (2006). In a running track of 400 meters, the volunteers were instructed to general stretching, followed by heating to 800 meters (two laps) in moderate trot. After ten seconds of passive recovery, they were subjected to a 1000 meter sprint at maximum intensity. The higher HR observed in this test model through Heart Rate Sensor Polar S610i (Polar Electro, Finland) was considered the MHR.

Session of jiu-jitsu Combat: The volunteers performed warm-up session that lasted approximately 20min, consisting of running around the mat, stretching and performing techniques of jiu-jitsu. The fighting session lasted approximately 25min, consisting of three jiu-jitsu fights with duration of 5 minutes each, followed by the same recovery period for a new contest. After the fighting, stretching and breathing techniques were performed for a return to calm, which lasted approximately 5min. Despite the three stages of the training session (stretching, fighting and return to normal), this research focuses only on analysis of the stage of fighting.

To monitor the HR behavior during the session, a fighting apparatus was used; Heart Rate Sensor model Polar S610i (Polar Electro, Finland). The tape transmitter was attached to the trunk of the volunteer, under the kimono, and due to intense movements performed during the practice of jiu-jitsu, the clock HR Sensor was strategically positioned on a wooden stick, which was sustained by the researcher who monitored the movement of the fighter under observation. This procedure was adopted to protect the device and preserve the physical integrity of the athlete.

Quantification of training load by PES: to quantify the training load by PES the method proposed by Foster et al was employed. (1996). Thirty minutes after completion of each training unit, a reference scale adapted from Borg (1998) was presented to the volunteers, from which they indicated the PES on the value (range 0-10 points). Furthermore, an evaluator monitored the duration of the session through a digital stopwatch. The score representing the training load through the PES was then calculated as follows by equation (1):

1)TL-PES PES x = t
Where: TL-PES = training load by perceived exertion session
t = duration of the session in minutes

Quantification of training load by HR: the method used for training load quantification through the HR was proposed by Edwards (1993). Effort was calculated through transfer of data to a specific program (Polar Precision Performance 4.0) time in the following target areas: (1) 50-60% (2) 60-70% (3) 70-80%; (4) and 80-90% (5) 90-100% of the predetermined MHR. Training load by HR was then calculated as eq (2):

2) TL-HR = (t 1 x 1) + (t2 x 2) + (t3 x 3) + (t4 x4) + (t5 x 5)
Where: t1 = time effort in the target area 1; t2 = time effort in the target area 2; t3 = time effort in the target area 3; t4 = time effort in the target area 4; t5 = time effort in the target area 5.

Data analysis: means and standard deviations of the variables were calculated in the analysis and the relationship between the different methods of quantifying training load was measured by the Pearson correlation coefficient (r). We adopted $p < 0.05$ significance level. The data were processed using SPSS for Windows, version 15.0.

RESULTS AND DISCUSSION

Table 1 presents the characteristics of research participants in relation to anthropometric measurements.

Table 1: Subject's anthropometrical characteristics.

	Mean	SD
Age (years)	21.4	3.9
Body mass (kg)	71.7	6.8
Height (m)	1.8	0.03
Body fat (%)	9.0	4.7

In relation to anthropometric characteristics, the participants of this research showed the value of body fat percentage similar to that presented by a Del Vecchio et al. (2007) study, which was attended by seven competitors in brazilian jiu-jitsu with titles in official championships. This similarity shows that the subjects of this research show body composition equivalent to practitioners of this modality in the competitive level.

Table 2 shows the means and standard deviations of variables related to the behavior of HR.

Table 2: HR behavior during the HRmax test and during sessions jiu-jitsu combat.

	Mean	SD
HRmax in field test (bpm)	183.40	10.19
HRmax in jiu-jitsu combat sessions (bpm)	192.20	9.73
HR mean in jiu-jitsu combat sessions (bpm)	153.0	14.0
HR mean in jiu-jitsu combat sessions (%HRmax)	79.5	4.8

Although not being part of the objectives of this research, the HR behavior during the sparring sessions attracted attention in some aspects. The HRmax average of this study was very close to what was reported by Del Vecchio et. al. (2007), with values of 192.02 and 195.07bpm, respectively. However, the value of HR mean in this study (153 ± 14bpm) was less than that reported by Del Vecchio et al (2007) in jiu-jitsu fighting (181.71 ± 5.96 bpm). This difference may be related to the different experimental protocols that were adopted, since in the present study the HR mean encompasses two periods of recovery that has not happened in the study by Del Vecchio et al (2007).

The differences in HRmax between the field protocol and session jiu-jitsu combat was also subject to further analysis that go beyond the research goals. This occurred because, interestingly, all volunteers submit HRmax in a combat situation greater than the figures in the field protocol for determining this variable. The result of Student t test for paired samples showed a significant difference ($t4 = -4.2241$; $p < 0.05$) between HRmax means obtained in the field and in combat. Different responses of HRmax were also reported in the literature when compared field and laboratory protocols for the determination of this variable (SANTOS et al., 2005). In this case, the field protocol for determining the HRmax were higher compared to laboratory protocols, and probably justified as the differences in environmental factors such as temperature and relative humidity. Despite these environmental variables were not controlled in this study, this may also have been a factor influencing the difference in values,

since the use of kimono during the fighting, jiu-jitsu causes a significant increase in temperature of the fighter. Furthermore, the field protocol used for determining HRmax in this study (adapted from SANTOS et al, 2005) adopted an effort of subjective maximum speed, there is no guarantee that the volunteers really made maximum efforts.

The results on the correlation between different methods (PES and HR) quantification of training load in session jiu-jitsu combats showed no significant correlation (r = 0.85; p> 0.05). Table 3 shows mean and standard deviation values for the two methods of quantification of training load. The Figure 1 shows the correlation between them.

Table 3 – Values of quantifying training load by diferents methods (PES and HR).

	Mean	SD
PES	206.1	40.2
HR	124.1	13.1

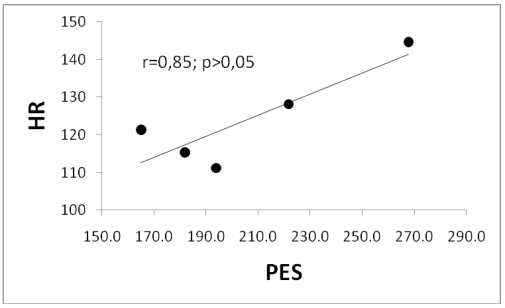

Figure 1 - Relationship between differents methods of quantifying training load (PES and HR)

This study aimed to correlate different methods of quantification of training load in a session jiu-jitsu combats. Detriment of the intrinsic relationship between HR and maximal oxygen consumption, the use of the HR monitoring has been the most common method for monitoring exercise intensity (DESGORCES et al., 2007). Thus, various methods have been developed to quantify the training load through the monitoring of HR and exercise duration (BANISTER, 1991; EDWARDS, 1993). However, monitoring heart rate during daily sessions of training in jiu-jitsu have some disadvantages. One of them is the cost for the purchase of Heart Rate Sensor. The other concerns the complexity of using the cardiofrequencymeter during the combat, as this mode is characterized by intricate physical contact, and there may risk the physical integrity of the practitioner and equipment damage. Thus, because of its easy application, the PES (FOSTER et al., 1995) is an excellent tool for quantification of training load for the daily lives of practitioners and coaches of jiu-jitsu.

In search of analyzing PES as a means to quantify the efforts in session jiu-jitsu combats, the present study sought to correlate the method of Edwards (1993), based on the behavior of HR, with the method of PES (FOSTER et al., 1995). However, the results showed no significant correlation (r = 0.85, p> 0.05) between these two methods during a session of three combats. Although there are no reports of studies that correlate different methods of quantifying training load in a session jiu-jitsu combats, other forms of struggle, such as judo (SERRANO et al., 2001) and MMA (Mixed Martial Arts) (AMTMANN et al., 2008) has been confronted with the behavior of PES a physiological parameter.

Aiming to determine the metabolic demand in MMA fights and verify the effectiveness of three different interval training programs in the physical preparation of athletes of this sport, Amtmann et al. (2008) used the blood lactate concentration and PES as a way to quantify the training load in six sessions of interval training that preceded the event of MMA and after the fighting in the days of event. The results showed that the MMA fights and training sessions required high metabolic demand, and the lactate concentrations of 15.2 ± 4.2 mmol.L-1 and 15.1 ± 3.1 mmol.L-1 respectively. Similarly, the PES showed high demand since the effort results in fighting and training sessions were 16.5 ± 2.5a.u. and 17.6 ± 1.2a.u. respectively, corresponding to the statement of "very tiring". However, this study did not do statistical analysis that could correlate the two methods of quantifying training load.

Serrano et al. (2001) analyzed the relationship between PES and maximum concentration of blood lactate in 13 male judo athletes after a combat session during a Official League, and the results showed a significant correlation between the methods (rs =0. 53; p<0.01). In this study, the values of maximum concentration of lactate and PES were 10.4 ± 0.6 mmol.L-1 and 7.3 ± 0.2a.u., respectively. Unlike the study by Serrano et al. (2001), was not found in our study a significant correlation between the two methods. This difference by having the basis of two arguments: 1) This research presents a limitation on the size of the sample (n = 5), a fact that may have led to no statistically significant correlation, since the coefficient correlation had a value of high correlation (r = 0.85), 2) The difference may also be contained in the various methods of quantifying training load used between studies, as in the study of Serrano et al. (2001) in PSE was confronted with the behavior of blood lactate concentration and in the present study with the HR behavior. Although the method of Edwards (1993) as being suitable for the quantification of training load in high-intensity intermittent exercise (FOSTER et al., 2001), yet there is not a correlation of this method with the blood lactate concentration, for example, as means of ensuring that the EdwardsTL method is most appropriate to validate the PES as a means of quantification of training load in a session jiu-jitsu combats.

The low number of participants and not using a more reliable physiological parameter to validate the PES in session jiu-jitsu combats appear as the main limitations of this research. In this sense, it is recommended that further research can be configured in order to gain more knowledge about the limitations and potential use of PES as a means of quantifying internal training load for coaches and physical trainers of practitioners jiu-jitsu and other martial arts

CONCLUSION

Our results suggest questionable validity of the method of quantifying training load based on perceived exertion in jiu-jitsu fighting session, at least when it is validated according to the method based on heart rate. Future studies are needed to investigate the association between physiological and other indicators of perceived exertion of sitting in different types of exercise, especially in the sport here investigated. It is still necessary to perform tests of reliability and reproducibility to prove the efficiency of the proposed model.

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CORRELATION BETWEEN METHODS OF QUANTIFYING OF TRAINING LOAD IN A SESSION OF COMBATS OF JIU-JITSU

ABSTRACT

The purpose of this study was to analyze the correlation between different methods of quantifying of training load in a session of combats of jiu-jitsu. Five male athletes from jiu-jitsu, aged between 18-27 years and with more than two years of practice, participated in this study. The participants underwent anthropometric measurements, medical history, assessment of maximal heart rate and three combats of jiu-jitsu with lasted of five minutes each and with equal time recovery between them. The participants signed the consent agreement agreeing in participate in this research. Heart rate was continuously monitored by cardiofrequency (Polar S610i) during the session of combat and after 30 min the participants indicated the perceived exertion of the session in a specific scale. From this, the training load was calculated by the methods based on heart rate and perceived exertion of the session (PES), as Edwards (1993) and Foster et al., (1996), respectively. The correlation between the different methods of quantifying training load was analyzed by the Pearson correlation coefficient. It was adopted $p < 0.05$ as the significance level. There wasn´t significant correlation ($p > 0.05$; $r = 0.85$) between methods of quantifying training load. The low number of participants and not application of more reliable physiological parameter to validate the PES in sessions of combats of jiu-jitsu are the main limitations of this research. In this sense, it is recommended that other research can be developed with the intent to have more knowledge about the limitations and potential of the use of PES as means of quantifying training load internal by coaches and physical trainers of jiu-jitsu fighters as well as the others martial arts.

CORRÉLATION ENTRE LES MÉTHODES DE QUANTIFICATION DE LA CHARGE D'ENTRAÎNEMENT DANS UNE SESSION DE LA LUTTE DE JIU-JITSU

RÉSUMÉ

Cette étude visait à analyser la corrélation entre les différentes méthodes de quantification de la charge d'entraînement dans une session de combat de jiu-jitsu. Cinq athlètes de sexe masculin jiu-jitsu, âgés de 18 à 27 ans et plus de 2 ans de pratique, ont participé à cette étude. Après signé un formulaire de consentement à participer à cette recherche, les sujets ont subi des mesures anthropométriques, les antécédents médicaux, l'évaluation de la fréquence cardiaque maximale et une troisième session du jiu-jitsu combat de 5 minutes chacune, avec un temps égal de récupération entre eux. La fréquence

cardiaque était surveillé en permanence par cardiofrequencymeter (Polar S610i) au cours de séances d'entraînement, et à 30 minutes par la suite, les bénévoles ont indiqué la perception de l'effort de la session sur une échelle spécifique. Les charges ont été calculées au moyen de méthodes de formation basée sur la fréquence cardiaque et l'effort perçu de la session (LPLS), comme Edwards (1993) et Foster et employés (1996), respectivement. La relation entre les différentes méthodes de quantification de la charge d'entraînement a été mesurée par la corrélation de Pearson. Nous avons adopté p <0.05 niveau de signification. Il n'y avait pas de corrélation significative (p> 0.05; r = 0.85) entre les méthodes de quantification de la charge d'entraînement. Le faible nombre de participants et ne pas utiliser un paramètre physiologique plus fiable pour valider le LPLS en combat jiu-jitsu sessions apparaissent comme les principales limites de cette recherche. En ce sens, il est recommandé que des recherches supplémentaires peut être configuré afin d'acquérir plus de connaissances sur les limitations et l'utilisation potentielle du LPLS comme un moyen de quantifier la charge d'entraînement pour les entraîneurs et les formateurs internes physique des pratiquants de jiu-jitsu et d'autres arts martiaux.

RELACIÓN ENTRE MÉTODOS DE QUANTIFICACIÓN DE CARGA DE ENTRENAMIENTO EN UNA SESIÓN DE COMBATES DE JIU-JITSU

RESUMEN

El presente estudio tuvo como objetivo analisar la corelación entre diferentes métodos de quantificación de carga de entrenamiento en una sesión de combates de jiu-jitsu. Cinco atletas de jiu-jitsu del sexo masculino, con edades entre 18 a 27 años y con mas de 2 años de practica, hicieron parte en este estudio. Después de firmaren el termo de consentimiento libre y aclarado concordando en participar de esta investigación, los voluntários fueron submetidos a una evaluación antropométrica, anamnese, evaluación de frequencia cardíaca máxima y una sesión de 3 combates de jiu-jitsu con duración de 5 minutos cada y con igual tiempo de recuperación entre ellas. La frequencia cardíaca fue monitorada continuamente por cardiofrequencimetro (Polar S610i) durante lãs sesiones de combate, y 30 minutos después de la misma, los voluntários indicaron La percepción subjetiva del esfuerzo de la sesión en escala específica. Calcularanse entonces las cargas de entrenamiento por medio de los métodos baseados en La frequencia cardíaca y percepción subjetiva del esfuerzo de la sesión (PSES), de acuerdo con Edwards (1993) y Foster et al., (1996), respectivamente. La relación entre los diferentes métodos de quantificación de carga de entrenamiento fue verificada atraves de la corelación Pearson. Fue adoptado p < 0.05 como nivel de significancia. No se encuentró corelación significativa (p>0.05) entre los métodos de quantificación de carga de entrenamiento, siendo el coeficiente de relación igual a 0.85. El numero bajo de participantes y la no utilización de un parametro fisiológico mas confiable para validar la PSES en sesiones de combate de jiu-jitsu configuranse como las principales limitaciones de esta investigación. En este sentido, recomendase que otras investigaciones puedam ser hechas con la intención de intensificar los conocimientos sobre las limitaciones y potencialidades de utilización de la PSES como medio de quantificación de carga de entrenamiento interna por entrenadores y preparadores fisicos de los practicantes de jiu-jitsu y otras modalidades de luchas.

CORRELAÇÃO ENTRE MÉTODOS DE QUANTIFICAÇÃO DA CARGA DE TREINAMENTO EM UMA SESSÃO DE COMBATES DE JIU-JITSU

RESUMO

O presente estudo teve como objetivo analisar a correlação entre diferentes métodos de quantificação da carga de treinamento em uma sessão de combates de jiu-jitsu. Cinco atletas de jiu-jitsu do sexo masculino, com idades entre 18 a 27 anos e com mais de 2 anos de prática, fizeram parte desse estudo. Após assinaram o termo de consentimento livre e esclarecido concordando em participar dessa investigação, os voluntários foram submetidos a avaliação antropométrica, anamnese, avaliação da freqüência cardíaca máxima e uma sessão de 3 combates de jiu-jitsu com duração de 5 minutos cada e com igual tempo de recuperação entre eles. A freqüência cardíaca foi continuamente monitorada por cardiofrequencímetro (Polar S610i) durante as sessões de combate, e 30 minutos após a mesma os voluntários indicaram a percepção subjetiva de esforço da sessão em escala específica. Foram então calculadas as cargas de treinamento por meio dos métodos baseados na freqüência cardíaca e percepção subjetiva de esforço da sessão (PSES), conforme Edwards (1993) e Foster et al., (1996), respectivamente. A relação entre os diferentes métodos de quantificação de carga de treinamento foi verificada através da correlação Pearson. Foi adotado p < 0.05 como nível de significância. Não foi encontrada correlação significativa (p>0.05; r=0.85) entre os métodos de quantificação de carga de treinamento. O baixo número de participantes e a não utilização de um parâmetro fisiológico mais confiável para validar a PSES em sessões de combate de jiu-jitsu configuram-se como as principais limitações desta pesquisa. Neste sentido, recomenda-se que outras pesquisas possam ser configuradas com o intuito de aprofundar os conhecimentos sobre as limitações e potencialidades da utilização da PSES como meio de quantificação de carga de treinamento interna por técnicos e preparadores físico dos praticantes de jiu-jitsu e outras artes marciais.