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***Original article***

# VALIDITY OF RPE SESSION IN YOUNG MALE KARATE ATHLETES

**PADULO JOHNNY[1,2], SALERNITANO GIANLUCA[2], MAURINO LUCIO [3], STEFANO VANDO[4], GEVAT CECILIA [5]**

**Abstract**

*Purpose.* This study aimed to assess the validity of the rating of perceived exertion (RPE) session method vs. HR-based methods (Edwards and Banister) for quantifying karate's training load (TL).

*Methods.* Eleven young karatekas (age 11.34±1.76 years, height 143±6.786 cm, body mass 48.13±7.33 kg, HRmax 205±0.98 bpm) participated in this study. The training sessions was performed on 5 consecutive days with two training sessions for day. During the training Heart Rate was recorded with Cardio "Suunto Memory-Belt" so to calculate the Trimp (Banister) and Training Load (Edwards), while the session-RPE scale is based on the Borg category ratio RPE scale and then modified by Foster et al (CR-10). The validity of RPE method in young Karate athletes, was studied by correlation analysis between RPE session's training load and both Edwards and Banister's training impulse score' method.

*Results.* The HR and RPE were collected from 10 training sessions with inter-day (two sessions for days) correlations were determined (n=11 × 5 days). The mean session-RPE values and correlations in each exercise mode between session-RPE and HR-based TLs (ie, Edwards's TL and Banister's TRIMP) showed TL, r = 0.79; 95% CI: 0.67 to 0.87 and Banister's TRIMP, r = 0.63; 95% CI: 0.44 to 0.77.

*Conclusion.* The results of the present study provide evidence that the session-RPE method is a simple and inexpensive tool that accurately provides a similar quantification of internal TLs as assessed by the HR-based methods during the various training modes with young karate practitioners. The complex physiological interactions during karate sessions that were dedicated for developing a wide variety of physical capacities makes it difficult for coaches to accurately quantify training load using HR or time measures. Thus, the session-RPE method provides a practical, low-cost, and non invasive tool of quantifying karate training loads, thus making it a valuable tool for athletes, coaches, and sports scientists.

*Key Words:* Young Karatekas; Perceived Exertion; Martial Art; Heart Rate.

## Introduction

Article I. The studies on karate's performance analysis have shown that combats sport requires repetitions of intensive short sequences of attack and/or defence that are interrupted by brief/active periods and/or passive recovery in-between (Beneke et al., 2004; Iide et al., 2008; Chaabene et al., 2013). Moreover, the latter physiological pathways showed that several studies have stressed the importance of performing appropriate training loads (TL) to enhance performance and have demonstrated, for instance, that some changes in performance can be mainly attributed to varying periods of easy and hard training loads (Foster, 1998). Nevertheless, for being able to schedule and monitor training loads in karate athletes, there is a need for a valid and accurate tool for assessing TLs (Haddad et al., 2011). In this regard, the coach's intuition about training loads may not be reliable for accurately monitoring training, given the complexity of training mode interactions (Barroso et al., 2013). The risk is that unsuitable training will be prescribed, which could result in detraining and/or overtraining or injury and, then, performance deterioration. Several methods that integrate exercise intensity and volume (Foster, 1998; Foster et al., 2001). Most of these methods, as heart rate (HR) response to exercise intensity and duration, provide objective measures of physical effort that might allow for the quantification of a training session as a unit of physical effort (Imamura et al., 1998). Although HR-based methods provide objective measures of TL, they appear to be a poor method for evaluating intensity during several intensity exercises (i.e., intermittent and plyometric exercises) (Foster et al., 2001). A method based on the perceived exertion during the entire training session (as session-RPE) was suggested by Foster et al. (Foster et al., 2001). This approach has been received increasing attention in recent years in compact sport (Haddad et al., 2011). Foster et al. (Foster et al., 2001) simplified the quantification of TL by substituting HR data by a session-RPE measure.

RPE is based on the observation that athletes inherently monitor the physiological stress they experience during exercise. RPE has been correlated with many physiological measures of exercise intensity, such as oxygen consumption ($VO_2$), ventilation, respiratory rate, blood lactate concentration, HR and electromyography activity, during a variety of exercise protocols (Fabre et al., 2013; Scott et al., 2013). Recently was studied (Impellizzeri et al., 2005) the relationship between the session-RPE method and three approach methods

(Banister's TRIMP, Edwards' summated-heart-rate-zones method, and Lucia's TRIMP) in during training and match play. Authors reported a significant individual correlations between the session-RPE method and Banister's TRIMP method (Banister, 1991) (r=0.65), and between the session-RPE method and Edwards' summated-heart-rate-zones method (Edwards, 1993) (r=0.70). A recent study by Milanez et al. (Milanez et al., 2013) analyzed the relationships between the RPE of a whole exercise session and objective measures of exercise intensity during a single karate training session. Significant relationships ($p<0.05$) were found between the mean TL session-RPE and mean lactate, percentage of maximum HR, and percentage of HR reserve. However, the relationship between session-RPE-derived TLs and HR-based TLs has not been fully assessed in elite karate players across a range of exercise modes. Therefore, this study assessed the validity of the session-RPE method across all typical training modes of a karate training program in young karate practitioners (Vando et al., 2013).

**Material and Methods**

Subjects

Eleven male youth Karate athletes (means ± SD: age 11.34±1.76 years, height 143±6.786 cm, body mass 48.13±7.33 kg, HRmax 205±0.98 bpm) volunteered to participate in the present study. All participants (i.e. both experimental and control group) had at least 3.5 years of karate training background with two to three karate training session per -week (total 3-4 hours per week). None of the subjects ever underwent any endurance strenuous activity or resistance training outside of their normal training program. The study conformed to the Declaration of Helsinki 1964 and was conducted after approval from the local Ethics Committee. The procedures, risks and goals were explained to the participants tutor and written parental consent was obtained prior to participation in addition to the subjects' consent.

Experimental set-up

According to "Italian Federation of Martial Arts (FILKAM)" guidelines, participants took part in a 1-wk Karate training camp consisting of one to two daily sessions planned by the team' coach. Maximum heart rate ($HR_{max}$) was estimated (220 – age) (Miller et al., 1993). Athletes were involved in two 60 minutes training session's inter-day (morning session and afternoon session for seven consecutive days) during the Summer Camp (Vando et al., 2013) included specific karate exercises performed as follows: 10 minutes of coordinative trunk, arms (simultaneity rotation: right vs. left) and legs exercises (alternating rotation: right vs. left) in different body planes in forward-backward displacement (distance of 15 meters); 15 minutes of flexions, lunges and extra-rotations of lower limbs exercises in different body planes followed by dynamic stretching (DS) postures (Haddad et al., 2013) performed in standing and seated positions. DS consisted of one sets of 7-min, five exercises with 30 sec each (i.e. five muscle groups: quadriceps, hamstrings, plantar flexors, adductors and hip flexors) Finally, 35 min of specific karate skills including upper and lower limb offensive and defensive techniques.

Monitoring Training Loads

Individual training load was calculated using the Foster's session-RPE procedure (Foster et al., 2001) for each day. This method involved multiplying the training duration in min by the mean training intensity. The session-RPE scale is based on the Borg category ratio RPE scale and then modified by Foster et al (Foster et al., 2001) (CR-10), which translates the athlete's perception of effort into a numerical score between 0 and 10. This test is designed to ask the athlete to respond to a simple question. ''How was your workout?'' with the goal of getting an uncomplicated response that reflects the athlete's global impression of the workout. In the present study, the validated French version of the CR10-scale was used (Haddad et al., 2011). All athletes had been familiarized to this scale before the start of the study (3 wk preceding the training camp) and followed standardized instructions for RPE.

Each athlete's RPE was collected approximately 30-min after each Karate session to ensure that the perceived exertion referred to the whole session rather than the most recent (end-of-session) exercise intensity. During the Karate competition, athletes' RPEs were collected ~5-min after each Karate fight to ensure that the perceived effort referred to the Karate combat. Fight session-RPE was calculated by multiplying this fight RPE by Karate fight duration.

Criterion Methods for Quantifying Physical Training Loads

Two HR-based training load methods were used to measure internal Training Loads (TL): Banister TRIMP and Edwards TL (Banister, 1991; Edwards, 1993). The Banister TRIMP (Banister, 1991) tries to weight the session duration using an exponential factor, as in the following formula:

- $TD \times HR_R \times 0.64e^{1.92.HRR}$

In which TD is the effective training session duration expressed in minutes and $HR_R$ is determined with the expression $[(HR_{TS} - HR_B)/(HR_{max} - HR_B)]$, where $HR_{TS}$ is the average training-session heart rate and $HR_B$ is the heart rate measured at rest. The HR-based method proposed by Edwards (Edwards, 1993) was also used as a common indicator of internal TL in various disciplines. The criterion-related validity between Banister's TRIMP and Edwards's TL was verified in many studies, such as that of Borresen and Lambert (Borresen & Lambert, 2009), who found high significant correlation between these two HR-based methods (r = 0.98; 95% CI: 0.96 to 0.99). Recently, this method was published in a review article of Borresen and Lambert (Borresen & Lambert, 2009) as

an index of training stress like Banister's TRIMP and Lucia's TRIMP. Practically all the research analyzing the ecological validity of session-RPE has used this HR-based method. This method determines internal load by measuring the product of the accumulated training duration (minutes) in five HR zones by a coefficient relative to each zone (>50–60% of $HR_{max}$ =1, >60–70% of $HR_{max}$ = 2, >70–80% of $HR_{max}$ = 3, >80–90% of $HR_{max}$ = 4, and >90–100% of $HR_{max}$ = 5), and then summing the results. Training intensity during each Karate training camp session (Vando et al., 2013) was recorded using HR monitors (Polar Team System, Polar, Kempele, Finland), with HR recorded every 5-s. After each training session, HR data were downloaded to a computer using appropriate software (Polar Advantage Software, Polar Electro, Oy, Finland). To assess resting HR, athletes did lay on a bed for 10-min at ~6:20 a.m.. The resting HR value corresponded to the minimal HR observed during this 10-min period.

Statistical Analysis

Data were analyzed using SPSS 15.0 statistical software package (SPSS Inc., Chicago, IL). Descriptive statistics were expressed as mean ± SD. The sample size was established with post-hoc statistical power analysis (Faul et al., 2007). Pearson product-moment correlation coefficients were calculated to determine whether session-RPE and the various HR-based TL methods were convergent. The magnitude of the correlations was determined using the modified scale of Hopkins: $r \leq 0.1$, trivial; >0.1–0.3, small; >0.3–0.5, moderate; >0.5–0.7, large; >0.7–0.9, very large; >0.9-<1, nearly perfect; and 1 perfect. Significance and meaningful acceptance of the correlation were set at 5% ($p < 0.05$) and 0.5 (large to perfect), respectively.

**Results**

The HR and RPE were collected from 10 training sessions with inter-day (two sessions for days) correlations were determined (n-11 × 5 days). The mean session-RPE values and correlations in each exercise mode between session-RPE and HR-based TLs (ie, Edwards's TL and Banister's TRIMP – Figure 1) showed TL, r = 0.79; 95% CI: 0.67 to 0.87 and Banister's TRIMP, r = 0.63; 95% CI: 0.44 to 0.77 with $p < 0.001$ respectively.

**Discussion**

The present study showed for the first time the application to Foster's RPE-based approach (Foster et al., 2001) to quantify internal TL during different modes of karate training in karatekas. Particularly, we determined the correlations between session-RPE and two HR-based methods widely considered to be valid indicators of internal TL during all modes of training sessions present at the training camp. The correlations between session-RPE and Banister's TRIMP and Edwards's TL were, r = 0.63 "moderate" and r = 0.79 "large", respectively. The magnitude of the association between the session-RPE and HR-based TLs was high enough to confirm that session-RPE can be used as a strong alternative for quantifying training loads during special physical training in young karatekas. These results are in according with the Foster study (Foster et al., 2001), who showed that individual correlations between the session-RPE method and Edward's TL ranged between r = 0.75 and 0.90.

In the present study, the correlation between session-RPE and Banister's TRIMP was r = 0.63 ($p < 0.01$) while Edwards's TL was r = 0.79 ($p < 0.001$), which confirms the validity of the RPE method as an accurate mode of training load monitoring during intermittent exercise. The study of Earnest et al. (Earnest et al., 2004) showed that the RPE method might provide ~~a~~ more accurate training load's monitoring compared to the other methods based on HR when both aerobic and anaerobic metabolisms are activated simultaneously.

**Conclusions**

This study provide evidence that the session-RPE method is a simple and low cost device that accurately provides similar quantification of internal TLs as assessed by the HR-based methods during the various training modes in karate sessions. The complex physiological interactions during karate sessions that were dedicated for developing a wide variety of physical capacities makes it difficult for coaches to accurately quantify training load using HR or time measures.

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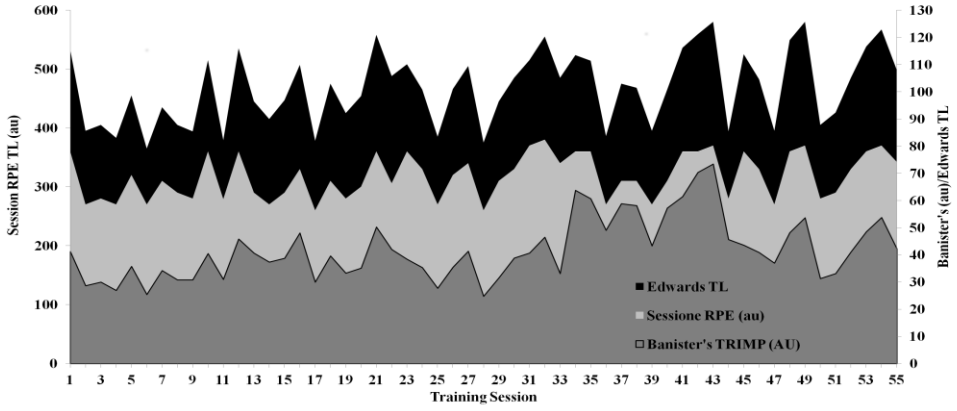


**Figure 1.** Profile of the session rate of perceived exertion training load (TL) vs. Edwards's/Banister's methods across the training sessions examined during the training camp.