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SHORT COMMUNICATION

A pilot study: session-RPE method for quantifying training load in judo athletes

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Abstract

This study aimed to verify the relationship between perceived exertion (session-RPE) and heart rate (HR) methods when quantifying internal training loads in different judo training sessions. Nine male judo athletes performed two training sessions lasting 60 min with a 48 h interval between them: (1) *randori* and (2) technical–tactical. The internal training load was quantified through the session-RPE (CR 0–10) and the HR methods, as suggested elsewhere (Banister's and Edwards methods). The Pearson's linear correlation was used to verify the relationship between session-RPE and HR methods ($p < 0.05$). A significant positive correlation was found between session-RPE and HR method as suggested by Banister's ($r = 0.93$; $p < 0.001$) or Edwards methods ($r = 0.81$; $p = 0.007$) in *randori* session. Accordingly, session-RPE was also correlated with HR of Banister's ($r = 0.90$; $p = 0.001$) and Edwards methods ($r = 0.81$; $p = 0.008$) in technical–tactical session. Results of the present study suggested that the session-RPE may be reliable to quantify training load during judo training *randori* and technical–tactical when compared to different HR methods.

Keywords Rating of perceived exertion · Heart rate · Combat sports · Training load

Introduction

Judo is an intermittent combat sport characterized by high-intensity effort periods interspersed by rest and low-intensity effort periods [1]. During a competition, medalist judo athletes perform five to seven matches, therefore, aerobic and anaerobic fitness levels are considered as an important factor [1, 2] to achieve success in judo competition. Actually, judo athletes use to engage in training programs to improve combat simulation (*randori*), technical–tactical training (*uchi-komi* and *nage-komi*), and physical preparation focused on these factors. In this regard, the monitoring of physiological (i.e., heart rate and lactate) and perceptual (i.e., perceived exertion and perceived fatigue) responses to training sessions may be useful when quantifying the dose–response relationship during training sessions [3].

Different training load monitoring methods have been mainly based on physiological aspects such as heart rate (HR) responses so that these HR-based methods have been commonly applied in sports training environments [3]. In this sense, while the HR method suggested by Banister called as training impulse (TRIMP) considers the HR responses to the training session duration, Edwards method

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recommends the use of a HR method based on the HR zones summation. Additionally, the fact that these methods rely on HR devices may constitute a practical problem, as HR monitors are not authorized during official judo competitions.

A likely alternative method to HR-based methods is the use of the ratings of perceived exertion (RPE) during a training session, as the session-RPE is considered as a simple and practical tool to quantify the intensity of training session. This method determines the training load by multiplying the individual RPE score by the training session duration (in minutes). This tool has gained considerable attention from athletes and coaches when quantifying the training loads as this is a noninvasive, inexpensive means to avoid overtraining and optimize sports performance [3].

Moreover, one may argue that session-RPE method is preferable when compared to HR-based methods as this method considers a perceptual rather than a single physiological response, as suggested by different combat sports studies [4, 5]. However, to the best of our knowledge, no study has been designed to verify the session-RPE and HR-based methods relationship when quantifying the training load in technical–tactical and *randori* judo training sessions.

Materials and methods

Participants and design

A sample size of nine subjects was required, considering a power of 0.80 and an effect size of 0.7, at a significance level of 0.05 with (G-power software 3.1.2; Germany). Thus, nine male judo university athletes were recruited to take part in this study. The anthropometric characteristics and time of practice were present in Table 1. Briefly, the athletes were national judo player, regularly training (physical, technical, and tactical training) 4–5 times a week when the study was performed. During two experimental visits athletes performed two training sessions (~ 60 min) in 2 days (interval 48 h). Experimental sessions with *randori* and technical–tactical were equally composed of general elements and fundamentals of judo, with addition of specific parts such as combat simulation in *randori* and *Uchi-komi* (technique repetition without throwing) and *Nage-Komi* (technique repetition with throwing) in technical–tactical session.

Table 1 Mean and SD of anthropometric characteristics and time of practice of judo athletes ($N = 9$)

Variable	Mean ± SD
Age (years)	23 ± 3
Height (cm)	170.5 ± 6.5
Body mass (kg)	76.3 ± 13.9
Body fat (%)	17.6 ± 8.3
Time of practice (years)	7 ± 3

Internal training load was quantified according to the following proposed methods. The session-RPE was calculated by multiplying the training duration in minutes by the RPE scored on the 10-points category ratio Borg's scale (CR10). Additionally, two HR-based methods were used to measure internal training load: The Edwards methods which determines the internal load by multiplying the accumulated training duration (minutes) in each HR zone by its corresponding coefficient (50–60% of HR_{MAX} in zone 1, 60–70% of HR_{MAX} in zone 2, 70–80% of HR_{MAX} in zone 3, 80–90% of HR_{MAX} in zone 4 and 90–100% of HR_{MAX} in zone 5), before summing them. In contrast, Banister's method considers the duration of the training sessions as the following Eq. 1:

$$\text{Banister's trimp} = \text{duration of training} \times \Delta\text{HRratio} \times Y, \quad (1)$$

where training session duration is expressed in minutes, ΔHRratio is determined as: $HR_{EX} - HR_{REST}/HR_{MAX} - HR_{REST}$ (where HR_{EX} is the averaged HR during exercise, HR_{REST} is the rest heart rate and HR_{MAX} is the maximal heart rate) and Y is $0.64e^{1.92x}$ for males and $e = 2.712$ and $x = \Delta$HRratio. The HR was recorded through a chest belt (Suunto, Vantaa, Finland), after each training session. The HR data were downloaded into a laptop computer using specific software. Individual training load session for RPE, Banister's and Edwards methods were demonstrated in Fig. 1.

Statistical analysis

The data normality and homoscedasticity were tested through the Shapiro–Wilk's test. Pearson's correlation was used to verify the relationship between session-RPE and HR-based methods of Edwards and Banister's in technical–tactical and *randori* sessions. The level of significance was set at $p < 0.05$. To make eventual comparisons possible, we also calculated the effect size (expressed as Pearson r) in post-hoc analysis, and interpreted as: $r = 0 - 0.1$ (trivial), $0.1 - 0.29$ (small), $0.3 - 0.49$ (moderate), $0.5 - 0.69$ (large), $0.7 - 0.89$ (very large), and $0.9 - 1.0$ (almost perfect).

Results

Figure 2 shows Pearson correlation coefficient between HR-based and session-RPE methods. Significant positive correlation was found in session randori session between

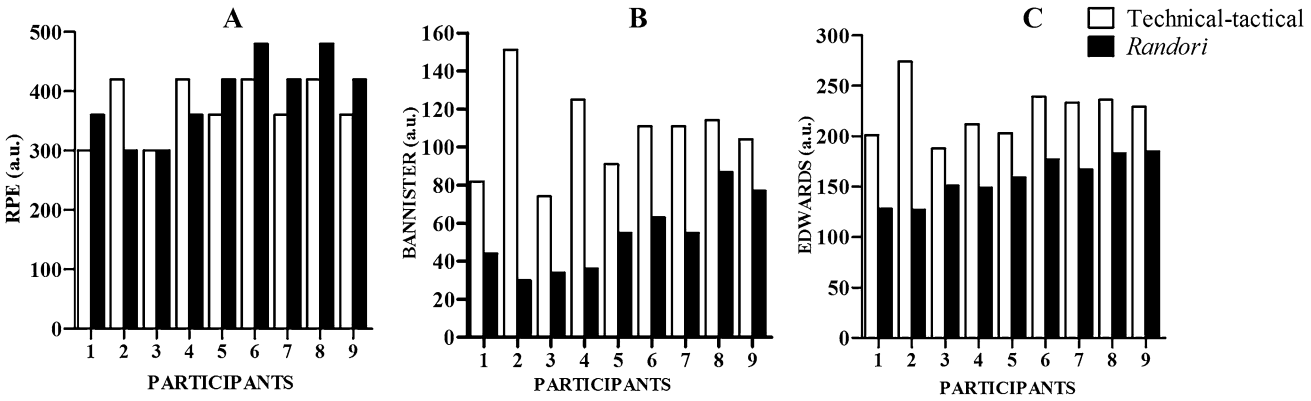

Fig. 1 Individual training load for session-RPE, and heart rate-based methods in the training session technical–tactical and *randori*. **a** Rating of perceived exertion; **b** Banister's method; **c** Edwards method

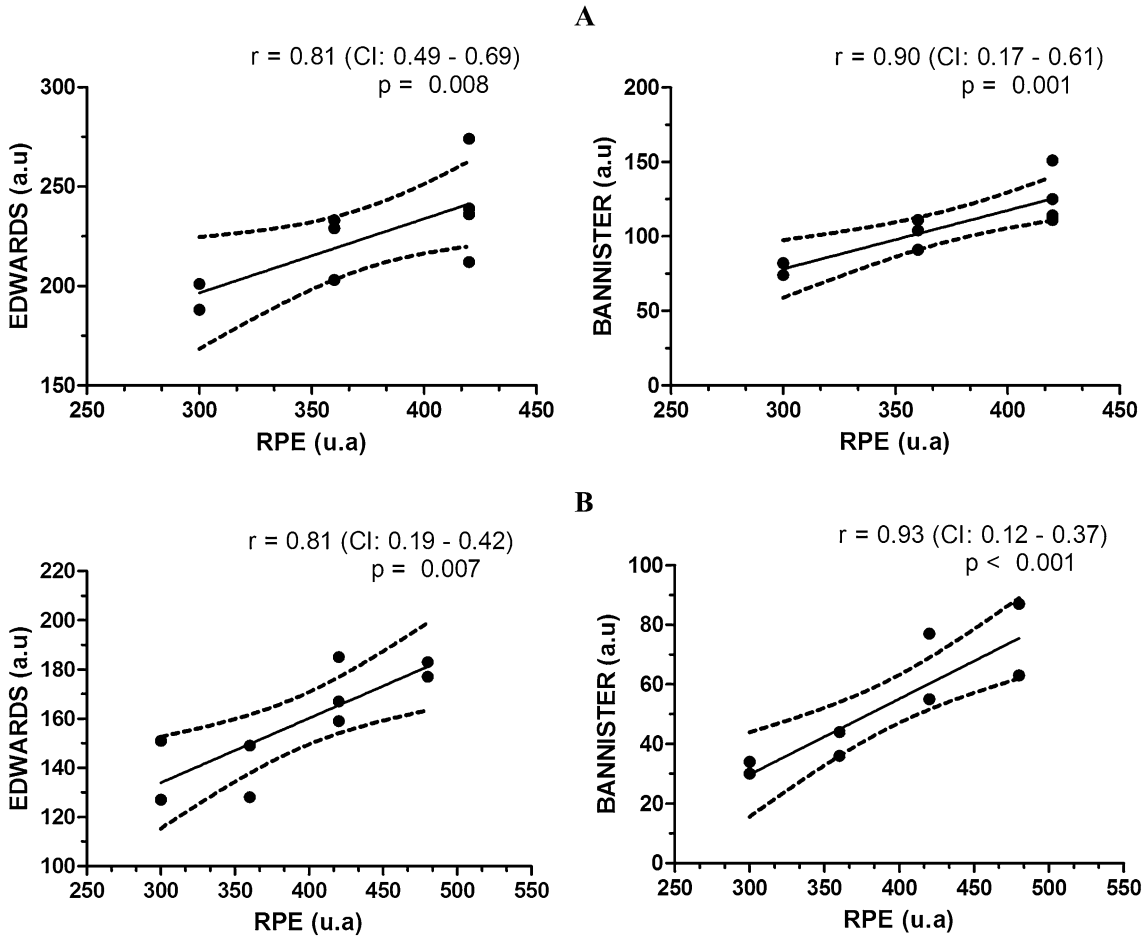

Fig. 2 Correlations between session-RPE methods and HR-based methods in the training session technical–tactical and *randori*. **a** Technical–tactical session; **b** *Randori* session

session-RPE and Banister's method ($r = 0.90$; almost perfect), and session-RPE and Edwards method ($r = 0.81$; very large). In technical–tactical session, we observed a positive correlation coefficient between session-RPE and Banister's method ($r = 0.93$ almost perfect), as well as session-RPE and Edwards method ($r = 0.81$; very large).

Discussion

The present study was the first investigating session-RPE and HR-based methods in judo athletes. The aim of the present study was to verify the relationship between training load quantified through session-RPE and HR-based methods such as Edwards and Banister's in judo athletes. Significant correlations between session-RPE and HR-based methods suggested a relationship between physiological and perceptual responses, likely making attractive the use of session-RPE to monitor training loads of judo athletes submitted to both technical–tactical and combat simulation sessions.

The technical–tactical training sessions of the judo involve a number of factors, including specific motor gestures such as *uchi-komi* (technique repetition without throwing) and *nage-komi* (technique repetition with throwing), using different techniques and time structures. In addition, tactical strategies to combat the opponent are also performed during these sessions [1]. The high correlation reported between both methods indicates that technical–tactical training session monitoring can be measured through session-RPE. Accordingly, similar results have been reported elsewhere, as significant correlations have been found between session-RPE and Banister's method ($r = 0.60$) as well as session-RPE and Edwards method ($r = 0.61$) in young taekwondo athletes [4].

Simulated combats in judo training sessions have been denominated as *randori,* which encompass a brief warm-up period followed by matches. The training load control in randori sessions is important, given the reliability of this type of training in simulating official competition [1]. Study by Invernizzi et al. [5] highlighted the usefulness of the session-RPE to monitor the training load when athletes matches at different intensities in karate combats. Similar to our study, Haddad et al. [4] assessed the relationship between session-RPE and HR-based methods for training loads monitoring and found a significant association between session-RPE and both HR Banister's method ($r = 0.74$) and Edwards methods ($r = 0.68$) in official taekwondo competition. Together, those earlier results and the present study may suggest the use of session-RPE in training load monitoring of combat matches in *randori* training as well as in official competition.

A likely limitation of the present study was the number of training sessions investigated, as we cannot confirm the session-RPE and HR-based methods relationship in longer-term training. However, this pilot study shows promising perspectives to future studies investigating session-RPE and HR-based methods in long-term training load in judo athletes. Results of the present study may suggest that session-RPE is a simple, low-cost and practical tool to quantify training loads in judo training and competition, given the session-RPE is a non-invasive, available mean to monitor judo-training loads in different scenarios. Thus, future investigations may be required to confirm the session-RPE utility in long-term judo training programs and official judo competitions.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflicts of interest concerning this article.

Ethical approval Ethical approval was obtained from the local Human Research Ethics Committee at the local university, in accordance with the Declaration of Helsinki.

Informed consent In the case of studies carried out on human beings, the authors confirm that the study was approved by the ethics committee and that the patients gave their informed consent.

References

1. Franchini E, Del Vecchio FB, Matsushigue KA, Artioli GG (2011) Physiological profiles of elite judo athletes. Sports Med 41(2):147–166. https://doi.org/10.2165/11538580-000000000-00000
2. Bonato M, Rampichini S, Ferrara M, Benedini S, Sbriccoli P, Merati G, Franchini E, La Torre A (2015) Aerobic training program for the enhancements of HR and VO_2 off-kinetics in elite judo athletes. J Sports Med Phys Fit 55(11):1277–1284
3. Halson SL (2014) Monitoring training load to understand fatigue in athletes. Sports Med 44:139–147. https://doi.org/10.1007/s40279-014-0253-z
4. Haddad M, Chaouachi A, Castagna C, Wong DP, Behm DG, Chamari K (2011) The construct validity of session RPE during an intensive camp in young male Taekwondo athletes. Int J Sports Physiol Perform 6:252–263. https://doi.org/10.1123/ijspp.6.2.252
5. Invernizzi SLP, Bizzi M, Benedini S, Merati G, Bosio A (2015) Interpretation and perception of two different kumite fighting intensities through an integrated approach training in international level karatekas: an exploratory study. Percept Mot Skills 121(2):333–349. https://doi.org/10.2466/30.06.PMS.121c19x4