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Impact of the internal training load over recovery-stress balance in endurance runners

Germán Hernández-Cruz*, Jeanette M. López-Walle*, José Trinidad Quezada-Chacón*, José Carlos Jaenes Sánchez, Blanca Rocío Rangel-Colmenero* and Luis Felipe Reynoso-Sánchez***

IMPACTO DE LA CARGA DE ENTRENAMIENTO INTERNA SOBRE EL BALANCE DE ESTRÉS-RECUPERACIÓN EN CORREDORES DE RESISTENCIA

KEYWORDS: RESTQ-Sport, S-RPE, university athletes, training period, psychological stress.

ABSTRACT: The aim of the research was to analyze the response in the recovery-stress balance perception and the internal training load in resistance runners. 18 trained runners (age: 20.1±2.7 years, weight: 64.2±7.63kg, height, 174.32±6.2cm, VO2max: 57.54±7.34L), participate in tests of 800m (five), 1500m (four), 3000m steeplechase (one), 5000m (five), 10,000m (one) and 21km (two). Three weeks of training monitoring was performed, in which two were of moderate load and one of intense load. The daily S-RPE (Foster et al., 2001) and weekly RESTQ-Sport were applied to evaluate the perception of training load and recovery-stress balance. The Shapiro-Wilk normality test was performed. A variance analysis was applied through the Friedman test, with post hoc Wilcoxon. The Spearman correlation coefficient between the RESTQ-Sport scales and the weekly S-RPE was analyzed. The results indicate that the S-RPE presented significant variations between the weeks, with week three reflecting the greater internal training load perceived. With respect to RESTQ-Sport, only the scale Disturbed Breaks (DB) shown significant differences, being this a specific scale of the sport, reflecting an increase in the perception of stress by the intensity of the training. There were no significant correlations, however, the S-RPE and the Disturbed breaks scale increased in week 3. The results coincide with other previous investigations in which the relationship between the increase in the training loads and the perception of this by the athletes.

Training loads are defined as the dose of physical work that the athlete must do during the entire exercise (Wallace, Slattery and Coutts, 2014). To improve athletic performance, training must involve a temporal process that generates progressive adaptations to training loads oriented at improving the abilities that runners need (Manzi, Iellamo, Impellizzeri, D'Ottavio and Castagna, 2009). This is why high training loads demand continuous subjugation to elevated levels of stress with small recovery periods, generating consequences in the physical and psychological well being of athletes that cause overtraining symptoms (Saw, Main and Gastin, 2015). Even though well-planned training based on previous and scientific evidence exists, athlete adaptation to training loads varies from one to another due to individual differences (Brink, Nederhof, Visscher, Schmikli and Lemmink, 2010).

To prevent maladaptive consequences by high training loads with little recovery, diverse methods have been proposed to quantify the individual athlete response, known as internal

Correspondence: Luis Felipe Reynoso Sánchez. Faculty of Sports Organization, Autonomous University of Nuevo León, Pedro de Alba st. San Nicolás de los Garza – Nuevo León –, 66455, México. E-mail: luis.reynososa@uanl.edu.mx
* Faculty of Sports Organization, Autonomous University of Nuevo León
** Pablo de Olavide University and Andalusian Center of Sport Medicine
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training load (Borresen and Lambert, 2009). Wallace, Slattery and Coutts (2009), used the Session-Rating of Perceived Exertion (s-RPE) and found that has a high sensitivity in intermittent high-intensity training in swimmers but not in continuous or low-intensity training; in addition, they mention that it is more precise in the overall assessment of a training session.

The s-RPE identifies the perception of the training intensity and it might be a predictor of the recovery demands generated in the athlete when subjected to high levels of stress, both physical or psychological. Physical stress is produced by the load/hours of training and the risk of suffering a lesion, while the psychological is related to the objectives of athlete performance, interpersonal relations, high demands, and other external factors to the sports practice (Fletcher, Hanton, Mellalieu and Neil, 2012; Reynoso-Sánchez et al., 2016). Another method used to measure the individual response to a training load is the RESTQ-Sport questionnaire (Saw et al., 2015), which, using subscales, was able to relate stress and recovery after high training loads in professional volleyball players (Freitas, Nakamura, Miloski, Samulski and Bara-Filho, 2014).

The importance of monitoring training loads and the recovery-stress balance lies in maintaining an optimal balance with the aim of reaching the peak athletic performance and avoid underperformance as well as overtraining (Kellmann, 2010). Therefore, the objective of this study was to analyze the response in the recovery-stress balance and the relationship with the internal training load in endurance runners.

Method

Participants

18 trained endurance runners with national and international experience participated (age: 20.1 ± 2.7 years; weight: 64.2 ± 7.63 kg; height: 174.32 ± 6.2 cm; VO2max: 57.54 ± 7.34 L); these were specialists in 800 m (five); 1500 m (four); 3000 m steeplechase (one); 5000 m (five); 10,000 m (one) and 21 km (two). A total of 15 hours training sessions per week were performed at the start of their preparation for the 2016-2017 season. Informed consent was obtained from the athletes as well as approval from the Bioethics Committee for Research in Health Sciences (COBICIS) of the Center for Research and Development in Health Sciences (CIDICS) of the Autonomous University of Nuevo Leon, Mexico (Registration no. COBICIS-801/2015/124-01HCG).

Instruments

S-RPE. The Session-Rating Perceived Exertion (s-RPE) is a validated method designed by Foster et al. (2001) for quantifying the internal training load in different sports with a low cost and immediate analysis (Halson, 2014). 30 minutes after finishing the training session, the athletes answer the following question: “How was your training session?” The athletes rate their effort on a scale of 0 to 10 (Rating Perceived Exertion, RPE). The s-RPE was calculated following the authors' recommendations (Foster et al., 2001).

RESTQ-Sport. The RESTQ-Sport is a questionnaire that evaluates the recovery-stress perception in athletes (Kellmann and Kallus, 2016). It has been validated in different languages and sports with a Cronbach's alpha greater than .70. The athletes mention the frequency with which they identify with physical and psychological states and diverse behaviors during the last three days and nights (Kellmann and Kallus, 2016). The questionnaire consists of 76 items on a Likert-type scale where 0 means *never* and 6 *always*. It is divided into 19 sub-scales that identify sources of stress and recovery that the athlete perceives and these are grouped into four dimensions. The dimensions are: *general stress*, identifies the sources of stress generated by daily life situations (subscales one to seven); *general recovery*, evaluates recovery resources related to personal and social issues (subscales eight to 12); *sports stress*, points out elements and situations related to sports practice that increase the levels of stress (subscales 13 to 15); and *sports recovery*, focuses on activities and the ability to recover to help the athlete have the best performance in sports practice (subscales 16 to 19).

Procedure

Data were collected during three weeks of training at the start of preparation for the season. Two weeks of moderate training were followed by a week in which the training load was increased. The s-RPE was obtained daily while the RESTQ-Sport was answered at the end of each week of training and 72 hours after finishing the third week.

Data analysis

SPSS statistics version 21 (IBM Corp., Amonk, NY) was used to calculate weekly training loads and the means of the subscales and dimensions of RESTQ-Sport. The variance of the means of RESTQ-Sport and weekly s-RPE was analyzed using Friedman´s test with the Wilcoxon post-hoc signed rank test. The correlation coefficient between s-RPE and RESTQ-Sport

was determined with Spearman´s correlation coefficient. For all statistical analyses, a $p < .05$ was considered significant.

Results

The results of the mean analysis of s-RPE and RESTQ-Sport are shown in Table 1. The results indicate that s-RPE presents significant differences between weeks and even days of training from the same week (see Figure 1) with week 3 being the one with the greatest number of sessions of perceived high intensity.

Regarding RESTQ-Sport, the coefficients of reliability of the questionnaire were greater than .70. Only the subscale of disturbed breaks showed significant differences between applications. No significant correlations were found between s-RPE and the subscales of RESTQ-Sport.

Discussion

The objective of this study was to analyze the response in the recovery-stress balance and the internal training load in endurance runners. The main contribution of our results is the evidence regarding the sensitivity of s-RPE in quantifying the training load in endurance runners. Likewise, the subscale of *disturbed breaks* from the RESTQ-Sport showed significant changes during the evaluation period. The changes in the perception of the internal training load go hand in hand with what was proposed by the trainer: two week of adaptation and one week of high load (week 3); this behavior was similarly observed in volleyball players (Freitas et al., 2014) in which the group under high training loads had a higher perception of training load.

The first day of week 1, athletes perceived high levels of training load, which can be considered part of the training adaptation process at the beginning of the season after a period of rest. This behavior coincides with that observed in the subscale *disturbed breaks*, whose levels in week 2 were significantly less than in week 1, in accordance with Kellmann and Kallus (2016), this subscale reflects the perception of inadequate planning of recovery times for athletes.

During week 3, two days of greater intensity were reached (Tuesday and Friday), an event that could have influenced the significant increase in the scale of disturbed breaks in week 3 with regard to week 2. Di Fronso, Nakamura, Bortoli, Robazza and Bertollo (2013), found in basketball players that during the pre-season, athletes tend to perceive higher levels of general stress, fatigue and risk of injury than during the season due to the high training loads that characterize this period. In a study of highly competitive soccer players with few recovery periods, while Laux, Krumm, Diers and Flor (2015), found a relationship between perceived increased fatigue, fewer breaks, the risk of injury, and inadequate quality of sleep with the onset of injuries.

One of the limitations of this study is its short duration, which makes it is necessary to increase the evaluation period. Therefore, we conclude that the use of instruments such as s-RPE and RESTQ-Sport is useful for monitoring training loads; in addition, the RESTQ-Sport is sensitive in the perception of recovery-stress, making it useful for improving athletic performance.

	Week 1	Week 2	Week 3	72 Hours
s-RPE	228.3 ± 65.2	195.3 ± 37.1	276.4 ± 70.1†	-
General stress	1.0 ± 0.9	1.1 ± 1.2	1.1 ± 1.1	1.1 ± 1.2
Emotional stress	1.5 ± 0.7	1.5 ± 0.8	1.4 ± 1	1.2 ± 0.9
Social stress	1.4 ± 0.9	1.5 ± 1	1.8 ± 1.4	1.4 ± 1
Conflicts/pressure	2.1 ± 0.9	2.0 ± 0.9	2.2 ± 1.1	2.0 ± 1.3
Fatigue	1.6 ± 0.8	1.8 ± 1.2	1.6 ± 1	1.6 ± 1.1
Lack of energy	1.9 ± 1	1.6 ± 0.8	1.8 ± 1	1.7 ± 0.9
Physical complaints	1.5 ± 0.9	1.6 ± 0.9	1.7 ± 1.1	1.8 ± 1.2
Success	3.7 ± 1.1	3.5 ± 1.1	3.3 ± 1.1	3.5 ± 1.5
Social recovery	4.1 ± 0.9	3.9 ± 1.3	3.9 ± 1	3.9 ± 1.4
Physical recovery	4.1 ± 1.1	3.9 ± 1	3.8 ± 1.2	3.8 ± 1.2
General well being	4.8 ± 1	4.7 ± 1	4.3 ± 1.1	4.6 ± 1.1
Sleep quality	3.9 ± 1.3	4.3 ± 1.2	4.0 ± 1.2	4.1 ± 1.4
Disturbed breaks	1.5 ± 1.1	1.0 ±1*	1.4 ± 1.2#	0.9 ± 1.1¶¥
Emotional exhaustion	1.6 ± 1.2	1.3 ±1.2	1.6 ± 1.5	1.7 ± 1.5
Injury	2.1 ± 1.8	2.0 ± 1.4	2.7 ± 1.6	2.0 ± 1.6
Being in shape	4.4 ± 1.3	4.4 ± 1.1	4.3 ± 1.3	4.2 ± 1.3
Personal accomplishment	3.6 ± 1.3	3.6 ± 1.2	3.7 ± 1.3	3.6 ± 1.6
Self-efficacy	4.6 ± 1.1	4.5 ± 1	4.6 ± 1.2	4.7 ± 1.1
Self-regulation	4.3 ± 0.8	4.1 ± 1.3	4.3 ± 1.3	4.3 ± 1.2

s-RPE, Session-Rating Perceived Exertion. *Significative difference ($p < .05$) regarding week 1. #Significative difference ($p < .05$) regarding week 2. ¶Significative difference ($p < .01$) regarding week 1. †Significative difference ($p < .01$) regarding week 2. ¥Significative difference ($p < .01$) regarding week 3.

Table 1. Means and standard deviations for the weekly s-RPE and the RESTQ-Sport subscales

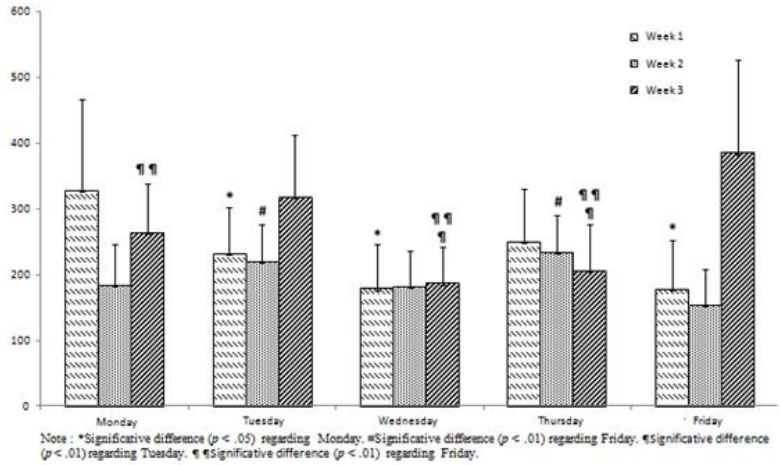

Figure 1. Internal training load perceived of each session

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PALABRAS CLAVE: RESTQ-Sport, S-RPE, atletas universitarios, periodización del entrenamiento, estrés psicológico.

RESUMEN: El objetivo de la investigación fue analizar la respuesta sobre la percepción del balance estrés-recuperación y la carga interna del entrenamiento en corredores de resistencia. 18 corredores de resistencia entrenados (edad: 20.1±2.7 años, peso: 64.2±7.63kg, estatura, 174.32±6.2cm, VO2max: 57.54±7.34L), participantes en pruebas de 800m (cinco), 1500m (cuatro), 3000m con obstáculos (uno), 5000m (cinco), 10,000m (uno) and 21km (dos). Se monitorearon tres semanas de entrenamiento, dos se realizaron con carga moderada y una con carga intensa. Se utilizó el S-RPE (Foster et al., 2001) diariamente y el RESTQ-Sport semanalmente para evaluar la percepción de estrés-recuperación. Se examinó la normalidad a través de la prueba Shapiro-Wilk y el análisis de varianza a través del test de Friedman con post hoc de Wilcoxon. Se analizó el coeficiente de correlación de Spearman entre las escalas del RESTQ-sport y el S-RPE semanal. El S-RPE tuvo diferencias significativas entre las semanas. La semana 3 presentó la mayor percepción de carga

interna del entrenamiento. El RESTQ-Sport presentó diferencias significativas en la escala de Periodos de Descanso Alterados (PDA), siendo ésta una escala específica del deporte, reflejando un incremento en la percepción de estrés debido a la intensidad del entrenamiento. No se presentaron correlaciones significativas, sin embargo, el S-RPE y la escala PDA muestran un incremento en la semana 3. Los resultados coinciden con estudios previos que señalan una relación entre el incremento de las cargas de entrenamiento y la percepción por parte de los atletas.

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