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Original Article

Monitoring training load in runners, throwers and sprinters/jumpers during a preparatory training camp

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Abstract:
Problem Statement: The rating of perceived exertion has been widely used to quantify training load during a given training session. Athletes of different modalities might differently respond to a given imposed training load. *Purpose:* The present study compared training load responses between runners, throwers and sprinters/jumpers. *Methods*: Ten young men (19.1 ± 2.2 years) and eight women (18.6 ± 1.1 years), who were athletes of running (n = 6), throwing (n = 5), and sprint/jump (n = 7) events, participated in this study. The athletes performed their training routine for one week with the rating of perceived exertion registered 30 minutes after each training session. Training impulse, monotony, and strain were calculated from the rating of perceived exertion and training duration. *Results*: The training impulse score was similar between the groups ($p > 0.05$). However, training monotony and strain were higher in runners compared to throwers ($p < 0.05$), but similar between runners and sprinters/jumpers and between throwers and sprinters/jumpers ($p > 0.05$). *Conclusions*: Even with similar training impulse, athletes of different modalities respond differently to the imposed training load. Our results suggest that runners have a higher training monotony and strain, compared to throwers. This might help coaches to understand the particularities of training modalities and therefore avoid maladapted response.
Key Words*:* Training impulse, monotony, strain, athletics, internal load.

Introduction

Performing exercise repeatedly is necessary to provoke adaptations in various physiological systems, which is associated with further improvement in exercise performance (Coyle, 2000). Frequent modifications in training load are required to carry for better training adaptations (Foster, 1998). Therefore, the quantification of training load helps the prescription of individualized exercise programs for different sports.

The measurement of the rating of perceived exertion (RPE) for a given training session has been widely used for quantifying the training load (Agostinho et al., 2015; Balsalobre-Fernández, Tejero-González, & del Campo-Vecino, 2015; Barnes, 2017; de Souza Carvalho et al., 2018; Foster, Rodriguez-Marroyo, & De Koning, 2017; Wallace, Slattery, & Coutts, 2009). This is calculated by multiplying the RPE of a training session (session-RPE) to the duration of the training session, resulting in a training impulse score (TRIMP) that represents the internal training load (Foster et al., 2001). The TRIMP has been validated against other more complex methods and it is a valid method for monitoring training load (Banister, Carter, & Zarkadas, 1999; Borresen & Lambert, 2008; Foster et al., 2001). Furthermore, the mensuration of session-RPE over a training period (e.g., one week) provides additional information such as training monotony (day-to-day variability of exertional effort) and strain (general stress of exertional effort), which depending of the score are associated with either overtraining or improved performance (Foster, 1998; Foster et al., 2017).

Because of its simplicity, the session-RPE has been used to measured training load in different modalities (Agostinho et al., 2015; Balsalobre-Fernández et al., 2015; Borresen & Lambert, 2008; Wallace et al., 2009). This strategy helps coaches in their training prescriptions, considering that athletes of different events might respond differently to the imposed training load (Esteve-lanao, San Juan, Earnest, Foster, & Lucia, 2005; Foster, De Koning, Gemser, & van Ingen Schenau, 1999; Foster, Hoyos, Earnest, & Lucia, 2005; Seiler & Kjerland, 2006). In particular, the athletics competitions involve several specialties and physical competences, which must differ in training load across the athletics modalities. It has been demonstrated that the training load for athletes of different endurance sports are similar (Foster et al., 2005). However, whether training load is

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similar for athletics athletes of different modalities such as runners, throwers and sprinters/jumpers are not known.

This is important because throwers and sprinters/jumpers might present a higher variability on their training due to the execution of more intense tasks involving the combination of speed, power and strength, when compared to runners who have a high volume of training (Billat et al., 2003; T. Bompa, 1991; Makaruk, 2007; Schmolinsky, 1993). In particular, runners training involves mostly continuous and extensive-intermittent exercises (e.g. continuous running, fartlek, and strength-training for endurance) whereas sprinters/jumpers executed mostly extensive and intensive-intermittent training (e.g. short speed endurance running, interval high-intensity running, standing and running jumps with loads, multiples jumps, hurdle jumps, skipping, and strength-training) and throwers performed intensive-intermittent to intense training (several exercises of strength-training, shot and medicine ball throws, half-squats, squats, and multiples jumps with loads). Moreover, a training camp strategy facilitates the integration between athletics modalities to improve the athlete's preparation during the preparatory period and can be used as a shocking week during the athletics basic periodization (Mouchbahani, 2009; Verkhoshansky, 1998).

Therefore, the aim of the present study was to compare the training load response between runners, throwers and sprinters/jumpers over a 1-week training camp. It is expected that the amount of TRIMP would be similar between the athletics groups considering their high training level, but the training monotony and strain should be higher in runners than in throwers and sprinters/jumpers due to the lower day-to-day variability of exercises in the former.

Material & Methods

Participants

Ten men (19.1 ± 2.2 years) and eight women (18.6 ± 1.1 years) participated in this study. Participants were athletics athletes and were classified according to the events: middle and long-distance runners (n = 6), hammer/discus throwers (n = 5), and sprinters/jumpers (n = 7). The athletes had been training regularly five to six times a week. To be part of the study, the participants had to have competed at national and international competitions; and (b) had no musculoskeletal injuries in the last year before the study. All participants signed the consent form in accordance with the principle of Declaration of Helsinki. The Local Ethics Committee approved the study.

Procedure

The study was carried out during a training camp of the preparatory phase of the annual training period. Participants always trained in the afternoon. The training sessions were conducted at the same time of day to avoid any influence of variations in circadian cycle (Racinais, 2010). Participants were familiarized with the session-RPE approach as they were used in their training routine. The athletes trained during six days into a week (Monday to Saturday) following their planned training program. Each athlete executed his/her specific training session and RPE was registered 30 minutes after the training session. Participants were asked "How was your workout?". They gave a score ranging from zero to 10 using a modified Borg CR10 Scale, where zero corresponding to "rest" and 10 to "maximal" (Foster et al., 2001). Training duration was taken from the beginning of warm-up until the end of the training session.

Training routines

The planned training program was made by an experienced coach and considered as a shock training week (moderate- to high-intensity). All training session started with a 20-min warm-up composed of jogging and stretching, followed by a 15-min of running educational exercises. After that, athletes executed the specific training for his/her modality with an approximate duration of 120 min. Runners executed continuous running, fartlek, technical running exercises, strength-training for endurance; throwers performed several exercises of strength-training, shot and medicine ball throws, half-squats, squats, multiples jumps with loads and technical throws exercises; and sprinters/jumpers short speed endurance running, interval high-intensity running, standing and running jumps with loads, multiples jumps, hurdle jumps, skipping, strength-training, and long/high jump techniques. At the end of each session, a 25-min cool down period was carried out. This training routine was repeated every day within one week.

Training Load Calculation

The TRIMP for each training session was calculated by multiplying the session-RPE score to the duration of the session and then sum, average and standard deviation for a one-week period were calculated (Foster et al., 2001). The training monotony was calculated by dividing the TRIMP average to its standard deviation. The training strain was calculated by the sum of TRIMP multiplied by the training monotony (Foster, 1998; Foster et al., 2001).

Statistical analysis

The data normality was checked using the Shapiro-Wilk's test. Homogeneity of variance between groups was verified by Levene's test. A one-way ANOVA was used to compare the training impulse, monotony, and strain between the groups (runners, throwers, and sprinters/jumpers). When necessary, the Bonferroni's post hoc test was used to locate the differences indicated by ANOVA. Data are presented as mean ± SD and 95%

confidence intervals (CI). Statistical significance was set at an alpha level of $P<0.05$. Data were analyzed using SPSS v.22 for Windows (SPSS Inc., Chicago, IL, USA).

Results

The TRIMP was similar between runners, throwers, and sprinters/jumpers ($F_{(2)}= 2.81$; $p = 0.09$, Figure 1).

Fig. 1. Training impulse in runners, throwers, and sprinters/ jumpers. Data are presented as mean ± SD ($p > 0.05$).

However, ANOVA detected a significant group effect for training monotony ($F_{(2)}= 4.46$; $p = .03$, Figure 2A) and strain ($F_{(2)}= 3.85$; $p = .045$, Figure 2B). Both training monotony and strain were higher in runners compared to throwers ($p = 0.029$ and $p = 0.048$, respectively). However, there was no significant difference in training monotony and strain between runners and sprinters/jumpers ($p = 0.78$ and $p = 0.99$, respectively) or between throwers and sprinters/jumpers ($p = 0.21$ and $p = 0.17$, respectively).

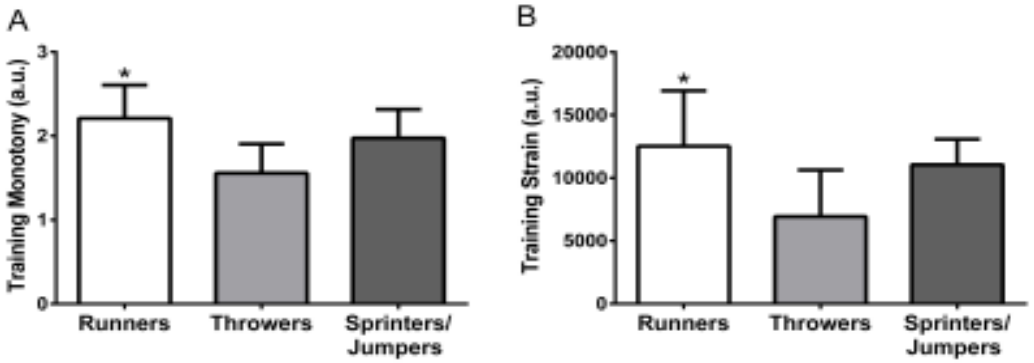

Fig. 2. Training monotony (A) and strain (B) in runners, throwers, and sprinters/jumpers. Data are presented as mean ± SD. * Significantly higher than throwers ($p < 0.05$).

Discussion

We investigated the training load responses between runners, throwers and sprinters/jumpers during a one-week training. As expected, the amount of TRIMP was similar between the groups. A novel finding of the present study, however, was that training monotony and strain were higher in runners than in throwers, but there was no difference between runners and sprinters/jumpers or between throwers and sprinters/jumpers.

In the present study, the TRIMP was similar between runners, throwers, and sprinters/jumpers. It has been demonstrated that elite athletes have a similar level of training load in individual sports (Foster et al., 2005). The amount of training load for elite Kenyan runners and elite junior skiers (~800 TRIMP per week) was similar to the training load found in our runners (~860 TRIMP per week) (Billat et al., 2003; Seiler & Kjerland, 2006). There is, however, no data for the training load of throwers and sprinters/jumpers during the preparatory phase, but we found that the magnitude of training load of throwers and sprinters/jumpers was not significantly different from runners, despite a slightly lower (non-significant) average values for throwers (~650 TRIMP per week). During the preparatory phase of the annual training period, the athletes of different events in athletics

share similar training program (Esteve-lanao et al., 2005; Makaruk, 2007; Schmolinsky, 1993; Verkhoshansky, 1998). Although the athletes execute exercises specific for each modality, the main aim of the preparatory phase is the same for all athletics' modalities similar that is to prepare the athlete to the pre-competitive period (T. Bompa, 1991; T. O. Bompa & Haff, 2009; Schmolinsky, 1993). Thus, this similar training load across athletics modalities was expected considering that all athletes were at the preparatory phase.

Although the TRIMP has been similar between the athletes of different events, the training monotony and strain was significantly higher in runners when compared with throwers. Although there is no large literature for training of throwers (Schmolinsky, 1993), it is notable the differences of training planning between runners and throwers. The training periodization of runners involves a larger amount of moderate- to high-intensity interval and continuous exercise and a higher volume of training (Billat et al., 2003; Esteve-lanao et al., 2005). In contrast, throwers executed a larger number of strength and power exercises with a lower volume of continuous training (Schmolinsky, 1993). These training differences reflected in a higher training monotony and consequently a higher training strain in runners than in throwers. Moreover, it has been proposed that training monotony should not exceed 2.0 a.u. in adults athletes to avoid maladaptive responses to training (Foster, 1998; Foster et al., 1999). In the present study, the training monotony of the runners was above this purposed "threshold" (~2.2 a.u.), while throwers maintained their training monotony below this value (~1.6 a.u). This result suggests that more attention must be paid in middle- and long-distance runners to avoid maladapted response provoked by reduced day-to-day variability of the training.

Interestingly, the training monotony and strain were similar between runners and sprinters/jumpers, and between throwers and sprinters/jumpers. The training of sprinters/jumpers involves a combination of speed, strength, and power exercises (T. Bompa, 1991; Makaruk, 2007; Ritzdorf, 2009; Schmolinsky, 1993). Because the trained capacities and training planning are similar between throwers and sprinters/jumpers, it should be expected no differences in training variability between throwers and sprinters/jumpers (T. Bompa, 1991; Makaruk, 2007; Schmolinsky, 1993). However, runners and sprinters/jumpers also demonstrated a similar training monotony and strain response. It should be highlighted, however, that training monotony of sprinters/jumpers was close to the purposed limit (~2.0 a.u.), which should be closely monitored to avoid the development maladaptive response.

Some limitations of the present study must be recognized. The literature about training load responses in throwers and sprinters/jumpers are limited, which difficult the comparison of our results with others. We also measured the internal load during the preparatory period and for one week only. Further studies should, therefore, quantify the training load during the pre-competitive and competitive phases and for larger periods. This will enable to verify how athletes of different events respond during the annual training periodization. However, our result has practical applications because during the preparatory phase athletes of different events normally train together at the same team commanded by the same coach (Borresen & Lambert, 2008; Schmolinsky, 1993). Moreover, this results can help coaches to avoid maladaptive responses that otherwise can carry for impaired performance (Esteve-lanao et al., 2005; Foster, 1998; Foster et al., 2017).

Conclusions

The integration of elements considered as part of the internal training load into single constructs seem to be of great importance and the session-RPE has been demonstrated as a simple and efficient method to quantify internal training load. In the present study, we showed that athletes of different events, despite had similar TRIMP over a one-week training camp period, present different training monotony and strain. Specifically, runners have higher training monotony and strain compared to throwers, but there is no difference between runners and sprinters/jumpers or between throwers and sprinters/jumpers. This data might help coaches to understand the training response of athletes from different athletics modalities.

Conflicts of interest - No potential conflict of interest was reported by the authors.
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