CASE STUDY: PRE-COMPETITION MONITORING OF FATIGUE AND WORKLOAD OF AN ELITE JUDO ATHLETE

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INTRODUCTION: Judo is a complex sport, which involves numerous tactical, technical and physical fitness determinants. Among them, it was reported that body composition, maximal strength, neuromuscular power, aerobic and anaerobic capacities were particularly relevant (Franchini et al., 2011). Therefore, an appropriate training program should focus on all these fitness components whereas technical and tactical aspects of performance also require sufficient training time. In order to optimize training adaptations, it becomes crucial to implement external and internal training load monitoring tools. While sRPE is an advantageous method of measuring internal training load (Coutts, 2014), training status monitoring should also consider other non-invasive markers such as psychometric questionnaires (perceived fatigue and general wellness) and countermovement jump (CMJ) performances (neuromuscular fatigue) (Buchheit, 2014; Halson, 2014). Therefore, the objective of this case study was to assess the efficiency of a monitoring program based on sRPE, psychometric questionnaires and CMJ performances for a judo athlete during a 6-week training phase prior to the 2014 world championships.

METHODS: CMJ testing sessions were held at the INS Québec on July 25th, August 1st, 8th, 15th and 22nd. On a daily basis the athlete had to score each training session based on the sRPE method (Foster et al., 2001). Weekly, typically on Saturday mornings, the athlete completed psychometric questionnaire (Cayrou et al., 2000). While CMJ and psychometric testing occurred only during the first 5 weeks, all other measurements were made for the complete 6-week period. sRPE and psychometric data were recorded using an internet-based monitoring tool (http://www.sportably.com). All scores were then exported to a standard spreadsheet (Microsoft Excel).

CMJ testing- After a general-to-specific warm-up, the athlete was asked to execute 3 individual maximal CMJ with the intention to jump as high as possible on each trial. Throughout the entire movement, both hands had to stay in contact with the hips. Jump depth during the eccentric phase was not controlled, but instructions recommended a 90 degree knee angle. All jumps were performed on a force plate (AMTI, USA), sampling at 1000 Hz. In addition to jump height (m), rate of force development (RFD in $N.ms^{-1}$), impulse (IMP in N·s) and the ratio between flight time and contraction time (FTCT) were also computed (Matlab, R2013b). The FT:CT ratio was calculated in accordance with the method used by Cormack (Cormack et al., 2008). All 3 jumps for each session were analyzed and the average values ± SD are presented.

Psychometric questionnaire- The athlete completed the Profile of Mood States – POMS questionnaire (Cayrou, et al., 2000) on a weekly basis. Global scores were then computed as described by previous researchers(Dupuy et al., 2012) to obtain an index for each of the following category: anxiety, anger, fatigue, confusion, fatigue and vigour. An energy index was also computed and represents the difference between the scores of vigour and fatigue (Dupuy et al., 2012).

Training load - Total weekly training load was computed by adding together each sRPE for that particular period. A monotony score was computed and represents the quotient between the average training load and its standard deviation for that particular week. TWTL and monotony scores are expressed as arbitrary units (AU).

RESULTS: Peak values are observed after week 3 (7130 AU). A taper phase is apparent afterwards while TWTL values gradually decrease to 5955 AU (week 4, 83% of peak values) to 3135 AU (week 5, 43% of peak values) to reach 540 AU during the last week (7% of peak values). A high (Munro, 2005) correlation was found between the POMS fatigue score and the TWTL ($r = 0.811$, $p = 0.096$).

Figure 2 represents the proportion of S&C vs. Judo to the TWTL. Training load for strength and conditioning was at its highest on week 2 while it decreases afterwards. Table 1 represents the evolution of all CMJ variables. While jump height and impulse appears rather stable, it seems that RFD and FTCT show a tendency towards improvement. From July 25th to August 22nd, the observed differences correspond to a change ((post-pre)/pre*100) of 26.6 % (RFD) and 10,4 % (FTCT).

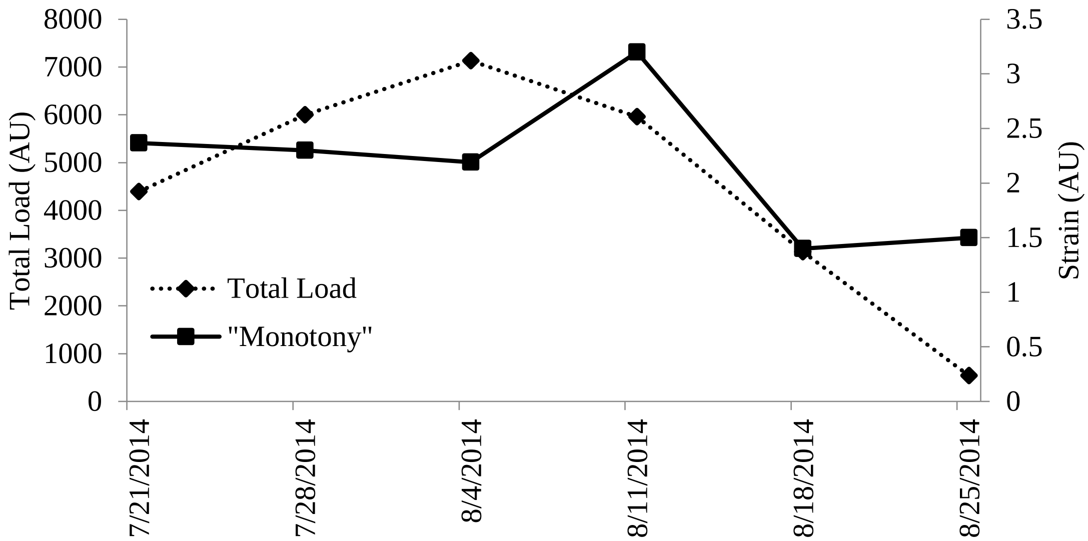

Figure 1 - Training Load

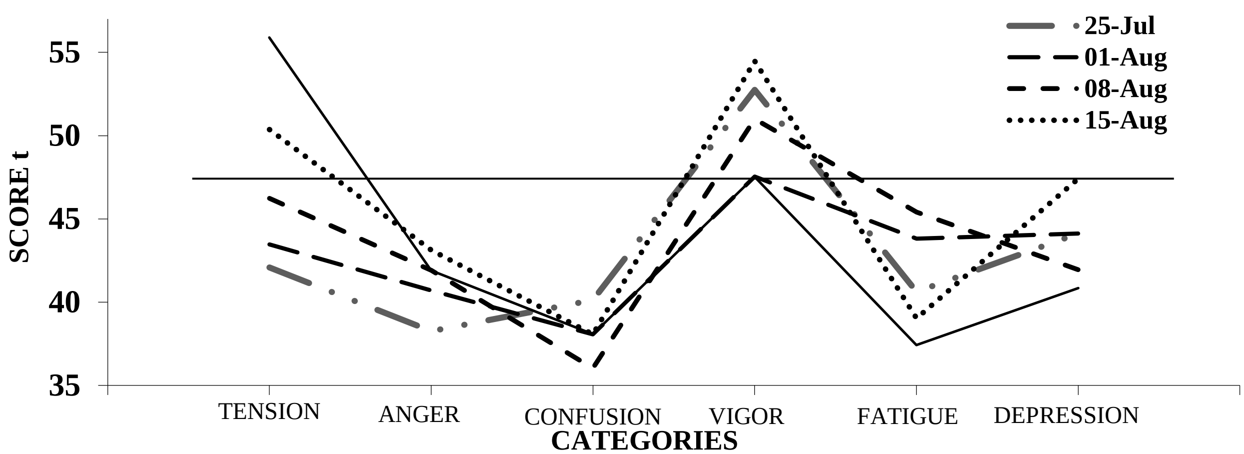

Figure 2 – Psychometric Data

DISCUSSION: Results revealed that the sRPE represents a simple method to assess total training load for a judo athlete. While TWTL was at its highest after week 3, a taper phase is clearly apparent afterwards. A classic meta-analysis (Bosquet et al., 2007) suggests that an appropriate taper phase should include a 40-60% reduction in training volume while intensity is maintained. It was also reported that the most efficient taper duration was 2-week long and involved no changes in training frequency (Bosquet. et al., 2007). In an interesting study with professional rugby players, it was shown that a 7-day taper phase including a 55% reduction in training time and 17.4% reduction in training intensity produced significant gains in isoinertial and isokinetic maximal strength (Coutts et al., 2007). Recently, it was shown that psychometric questionnaires were sensitive to the training load and that these tools were easy to implement in the field

(Dupuy, et al., 2012). Results from this case study are in line with these observations. A high correlation was found between TWTL and the fatigue score (POMS). Interestingly, it appears that the training load was well tolerated by the athlete as a positive energy index score was observed throughout the monitoring period. Considering these favourable observations and the relevance of the provided information (quantifying energy and fatigue), it is suggested that the POMS should be maintained in the monitoring program.

Table 1: Neuromuscular Data

	RFD		Impulse		FTCT		Height	
	$N{\cdot}ms^{-1}$		N·s				m	
	M	SD	M	SD	M	SD	M	SD
25-Jul	4.62	0.707	233.50	2.970	0.60	0.067	0.38	0.014
01-Aug	5.85	0.241	233.59	3.635	0.63	0.048	0.39	0.011
08-Aug	5.87	0.311	229.68	1.631	0.65	0.031	0.37	0.006
15-Aug	5.71	0.516	231.90	3.869	0.66	0.029	0.38	0.012
22-Aug	5.85	0.676	231.05	1.344	0.66	0.045	0.38	0.005

It was recently suggested that neuromuscular parameters (Jump height, RFD, IMP and FT:CT) as measured during a CMJ task should also be implemented in a complete monitoring program (Cormack, et al., 2008; Gathercole et al., 2014; Halson, 2014; Spiteri et al., 2013). In this case study, it could be suggested that the athlete tends to be more efficient in his jumping strategy whereas, even though jump height remains rather constant, an improved FT:CT ratio seems apparent. Interestingly, variability, as measured with the intra-session SD, seems to be reduced towards the end of the monitoring protocol. Whether these values should be considered as true improvements remains to be confirmed especially since, considering that it was the first time CMJ were measured on a regular basis with this athlete, a learning curve should not be excluded. Monitoring these variables over longer period of time will help in identifying those that are more sensitive to the TWTL for given individual athletes.

CONCLUSION: The observed results support these tools as being relevant and convenient in a monitoring program. Future experimentations should focus on an individualized taper strategy to increase strength and power, and on the interpretation and significance of all neuromuscular variables measured during a CMJ.

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