17. MONITORING TRAINING

O-099 Monitoring training loads in top-level professional rugby league

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OBJECTIVE There is limited research that describes periodisation models for football. Recent studies have shown the session-RPE method (Foster et al., 2001) to be a valid tool for quantifying training load (TL) (Foster et al., 2001; Impellizzerri et al , 2004). There have been no studies that have described the training loads undertaken by top level professional rugby league players. The objective of this study was to measure and describe the training periodisation of a top level rugby league club during a season.

METHODS Thirty eight professional players from the same club reported RPE (CR-10) within 30 minutes of finishing each training session. The TL, monotony and strain were determined using previously described methods (Foster et al., 2001). Data was collected for each session during the distinct training phases of the season. ANOVA was used to determine any changes in TL during each of the training phases.

RESULTS There were significant differences in the mean weekly TL and strain between the various phases of the season. The mean weekly TL's and strain were greater in the preparation than the competition phases (P<0.01). The match loads during the competition phase did not significantly change. Table 1 shows periodisation of TL's for the various training activities during the training phases.

Table 1. Training loads for the various training activities during the different phases of the season.

	General	Specific	Match Practice	Competition
Conditioning	1452 (214#**)	1036 (354* ^{†‡})	699 (188*)	380 (342*#)
Strength	519 (263)	815 (302 ^{†‡})	494 (127 [#])	379 (136 [#])
Skills	453 (101 ^{#†})	790 (192*)	698 (120*)	613 (209)
Other	201 (161 [#])	489 (89 ^{*‡})	348 (172 [‡])	150 (89 ^{#†})
Match			371 (70)	479 (110)

* Sig. diff. to General; [#] Sig. diff. to Specific; [†]Sig. diff. to Match Practice; [‡] Sig. diff. to Competition

DISCUSSION In this study TL's were greater than those reported for semi-professional rugby league (Coutts et al., 2003) but less than high level endurance athletes (Foster et al., 1997). The present data showed that TL's were reduced during the competition phase to promote recovery between each match. These results show a periodised training structure in top level rugby league and support the use of session-RPE for monitoring TL's in football.

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KEY WORDS Periodisation, training load, rugby league, session-RPE

O-100 Physical loading, stress and recovery in a youth soccer tournament

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OBJECTIVE Different variations in the heart rate beat provide important information which can be used for monitoring physiological loading and stress-recovery process. Heart rate and rate variability (HRV) have been used to asses training effect indirectly by using EPOC prediction method (Rusko et al. 2003). HRV indices are field-capable variables to reflect stress-recovery processes (Hynynen et al. 2006). The purpose of the research was to study physical loading of young international level Finnish soccer players (n=10, age 16.9 + 0.2 yrs) in training and match conditions and stressrecovery state between training and match days during a competitive soccer tournament based on the heart rate variability measurements. **METHODS** MaxVO₂, MaxHR, AerT and AnT were determined (Nummela, 2004). Players used Suunto t6 wristop computers in training sessions and 3 matches collecting RR-interval data during 6 days for EPOC and for nocturnal RRI-data collection. ACN system modulation was analyzed with HRV indices by using Firstbeat PRO software (Ket-tunen & Saalasti 2002). The players self-rated their perceived exertion and recovery.

RESULTS Mean MaxVO₂ was 53.5 ml/kg/min, MaxHR 198 bpm, AerT 38.0 ml/kg/min and AnT 46.3 ml/kg/min. EPOC values were in light and heavy training sessions18 and 72 ml/kg (p<0.001), respectively. EPOC values in matches were 213, 150 and 136 ml/kg (p<0.01). Average NHR after each match were 53, 50 and 51 bpm (ns). NHRV stress index was 0.061, 0.053 and 0.064 (ns), and recovery index 98, 103 and 98 (ns).

DISCUSSION The results indicated that maximal oxygen uptake had significant relationship to the perceived exertion in training sessions and matches and the loading of the whole tournament. According to the HRV stress and recovery indices the stress level was at highest after the first and last match. In conclusion, the HRV measurements analysed by the Firstbeat PRO software can be applied to soccer.

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KEY WORDS Soccer, physical loading, stress, recovery.

O-101 Physical features of American football players in post and pre-season period

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OBJECTIVE American football is a sport that demands high body contact at all levels of the game. Therefore an American football player needs a variety of physical components which are muscular strength, endurance and power. The purpose of this study was to compare the physical condition, in terms the muscular strength, endurance and power, of American football players in post and pre-season period.

METHODS There were eleven American football players in this study. Their mean age, height, mass, and BMD were 21.6 (2.3) years, 1.81 (0.01) m, 89.4 (16.6) kg, 1.303 (0.2) gr/cm2, respectively. Leg strength data were recorded with the isokinetic dynamometer. Lateral trunk flexions, core and back endurances, and vertical jumps were used to analyze the efficiency of the off season period activity of players.

RESULTS Current study findings (Table 1) demonstrated that there were only significant differences between post and pre-season period in lateral trunk flexion and vertical jump performances (p<0.05). In addition, the leg strength measures did not show any statistically significant differences between two periods (p<0.05),

period.											
	Exter @60°/	nsion s. (%)	Flexion (%	@60°/s 6)	Trunk Ext. (cm)	Later: flex	al trunk . (cm)	Endura	nce (sec)	VJ (cm)	FJ (cm)
	Means (SD)			Means (SD)			Means (SD)		Means (SD)		
	D	Ν	D	Ν		R	L	Core	Back		
Pre-SE	258.4	259.6	132.9	123.6	19.4	25.9	26.3 *	222.9	157.9	.28 *	.42 *

(3.6)

23.5

(4.1)

(6.0)

22.8

(3.9)

(54.1)

240

(0.0)

(62.3)

122.9

(54.1)

(.02)

.20

(.07)

(.05)

.38

(.05)

(4.5)

17.5

(2.1)

Table 1. Comparison of physical conditioning parameters of American football players in post and pre-season (SE) period.

* p<0.05

Post-SE

(46.3)

247.1

(43.6)

(47.2)

243.6

(43.7)

DISCUSSION Findings supported that there should be well-designed off season training program to compensate the physiological demands of the beginning of the season.

KEY WORDS American football, physical condition, muscular strength.

(26.1)

128.2

(23.5)

(20.9)

123.5

(23.7)

O-102 Changes in aerobic fitness in response to a season of professional Australian Rules Football

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OBJECTIVE Australian Rules football (ARF) players have been reported to cover 12.5 ± 1.7 km in a game 1. This suggests that it may be important to improve aerobic fitness to optimise performance. Indeed, enhanced aerobic endurance in soccer players has been reported to improve performance by increasing the distance covered and increasing the number of sprints and involvements with the ball during a match 2. While it is relatively easy to improve aerobic fitness during the pre-season, it is not known whether ARF players are able to maintain, or improve, their aerobic fitness during the competition season. The objective of this study was therefore to examine changes in aerobic fitness in elite ARF players during an entire season.

METHODS Eighteen senior members of a professional ARF club were tested at 3 different time points throughout the season (beginning of pre-season, end of pre-season, end of competitive season). Testing included an incremental treadmill test for the determination of VO₂max, the lactate threshold (increase in lactate > 1 mmol/L) and running economy at 10 km/h.

RESULTS During the pre-season period, there was a significant increase in the lactate threshold $(11.2 \pm 1.8 \text{ to } 13.0 \pm 1.1 \text{ km/h})$, running economy $(36.8 \pm 2.9 \text{ to } 34.8 \pm 2.6 \text{ mL/kg/min})$ and VO₂max $(56.0 \pm 4.5 \text{ to } 58.4 \pm 3.8 \text{ mL/kg/min})$. At the end of the competition season, there was no significant change in either the lactate threshold $(12.4 \pm 1.4 \text{ km/h})$; P=0.464) or running economy $(34.6 \pm 2.6 \text{ mL/kg/min})$.

DISCUSSION This is the first study to document changes in aerobic fitness of elite ARF players over a season. Consistent with previous reports for professional youth3 and adult4 soccer players, the aerobic fitness increased over the preseason. However, despite less time allocated for fitness training as the season progressed, players were able to maintain their aerobic fitness during the competitive season.

 $\textbf{KEY WORDS} \ Longitudinal \ changes, \ lactate \ threshold, \ running \ economy, \ VO_2max$

O-103 Effects of a hypertrophy and a maximal strength training program on speed, force and power of soccer players

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OBJECTIVE Recent studies, have shown a strong relationship between maximal half-squat strength and movement velocity (Wisloff et al, 2004) and suggested that training using heavy weights (>85% 1 RM) may be preferable for soccer players (Hoff and Helgerud, 2002). However, no study has compared this type of training with a program using lower loads commonly used for resistance training in soccer. The purpose of the present study, which had Ethical Committee approval, was to examine the outcomes of two different resistance training programs (half-squat) performed 3 times/week for 6 weeks during the pre-season period. One program was designed to promote muscle hypertrophy (H, 4 sets x 12 reps, with 70% 1RM) and the other aimed to increase maximal strength (S, 4 sets x 5 reps, with 90% 1RM).

METHODS Eighteen male soccer players were divided in two equal groups. The force-velocity characteristics [maximal force at zero pedal speed (Fo) and maximal pedal speed (Vo)] of each player were determined using short maximal sprints on a Monark cycle ergometer against different loads (Arsac et al. 1996). Maximal half squat strength and field-test performance was measured before and after training.

RESULTS Maximal squat strength increased significantly more in the S compared to the H group $(9.9\pm1.2\%$ and $17.3\pm1.9\%$). Lean leg volume was increased only in the H group (by $4.3\pm0.8\%$), but was unchanged in the S group. Fo was increased only in the S group. Improvement in squat strength was correlated with improvement in 10 m sprint time (r=0.67 P<0.01) and vertical jump (r=0.63 P<0.01).

	Half squat strength (kg)		Fo (Kg)		10m spri	nt time (s)	Vertical jump (cm)		
	Н	S	Н	S	Н	S	Н	S	
BT	140 (10)	152 (11)	19.4 (.5)	18.8 (.8)	1.88 (.03)	1.87 (.02)	48 (1.8)	50 (1.7)	
AT	154 (11) **	179 (13)**	19.9 (.5)	19.9 (1.0)*	1.86 (.03)**	1.84 (.02) **	50 (1.8)**	55 (1.8)**	
t D	0.5	0 1 0							

Table 1. Changes in force-velocity parameters, half-squat strength and field test performance before (BT) and after training (AT).

* P<0.05, ** P<0.01 from before training

DISCUSSION The increase in maximal strength in the S group, without an increase in lean leg volume would imply that strength was increased due to neural adaptations. Expressing strength gain per unit lean leg volume resulted in a 3 to 5-fold greater increase in strength in the S compared to the H group. These results suggest that resistance training using high loads may be preferable for soccer training.

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KEY WORDS Force-velocity relationship, resistance training, field tests, cycle ergometer.

O-104 Effect of additional in-season aerobic high-intensity drills on physical fitness of elite football players

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OBJECTIVE Recent studies have shown that match-specific physical fitness decreases towards the end of the season for a large number of elite football players (Krustrup et al., 2003). This may be related to fewer intense training sessions during the competitive season, due to a need for recovery after matches and focus on tactical training. Although positive effects of additional high-intensity off-season drills and in-season dribbling have been observed for junior players (McMillan et al., 2005; Impellizzeri et al., 2006), it is still to be examined whether an extra 30-min per week with small-sided interval games would improve performance of soccer-related intermittent running and repeated sprint ability of elite players during the competitive period.

METHODS Sixteen elite soccer players carried out additional aerobic high intensity training once a week (0.9±0.1) for 12 weeks. Each session lasted 30 min and consisted of small-sided games, organized as interval training with 2-4 min work intervals separated by 1-2 min of rest. Several physiological tests (Yo-Yo IR2 test, incremental treadmill VO2max test, repeated 30-m sprint test) were performed before and after the intervention period.

RESULTS After the intervention period, performance of the Yo-Yo IR2 test was improved by 15% (980 \pm 42 vs. 851 \pm 35 m, n=15; P<0.001) and VO₂max was improved by 5% (62.2 \pm 1.3 vs. 59.1 \pm 0.9 ml O₂/kg/min, n=12; P<0.05). The best 30-m sprint time was unaltered after 12 wks (4.22 \pm 0.03 and 4.24 \pm 0.03 s; P=0.54), whereas fatigue time in a repeated sprint test was lowered (0.19 \pm 0.02 vs. 0.24 \pm 0.02 s, n=14; P<0.05).

DISCUSSION Additional high intensity 30-min drills performed once a week markedly improved aerobic power, anaerobic capacity and football-specific intermittent exercise performance of elite football players during the competitive season.

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KEY WORDS Intense intermittent-exercise training, VO₂max, Yo-Yo Intermittent recovery level 2 test.