

A NEW APPROACH TO MONITOR STRESS AND FATIGUE DURING ALTITUDE TRAINING IN ELITE ATHLETES

García-Ramos, A.¹, Feriche, B.¹, Iglesias, X.², Calderón, C.³, Chaverri, D.², Barrero, A.², Nebot, V.⁴, Schuller, T.⁵, Štrumbelj, B.⁶, Qiu, J.⁷, Rodríguez, F.A.²



¹ FCAFD, University of Granada (Granada, Spain), ² GRCE, INEFC, Universitat de Barcelona (Barcelona, Spain), ³ CAR Sierra Nevada (Granada, Spain), ⁴ Catholic University of Valencia (Valencia, Spain), ⁵ Deutsche Sporthochschule Köln (Cologne, Germany), ⁶ University of Ljubljana (Ljubljana, Slovenia), ⁷ Shanghai Institute of Sport Science (Shanghai, China)



Aim

The total score of fatigue, a self-reported 8-items questionnaire (TSF-8) has been used as a valid indicator of training stress and fatigue in swimmers (Atlaoui et al., 2007). However, TSF-8 doesn't include assessment of items such as arms and shoulders fatigue or appetite, which are especially relevant in the management of fatigue and health status in swimmers, particularly when training at altitude.

This study aims to contrast the validity of a modified questionnaire (TSF-10) that incorporates two news items (tiredness of upper extremities and appetite control) by comparing both methods with session-RPE and Lake Louise acute mountain sickness questionnaire in elite swimmers training at altitude.

Methods

34 elite swimmers participated on an altitude training camp (CAR Sierra Nevada, 2.320 m) during three consecutive weeks (Wk 1–Wk 3). Subjects answered three self-reported questionnaires during the training camp.

Questionnaires

- RPE-10: filled in within 30 min after each training session, to calculate session-RPE (Foster et al. 2001) and then weighed by all daily training sessions according to its duration (s-RPEw)
- TSF-10 (figure): a modified TSF questionnaire with two added items (tiredness of arms and shoulders and appetite) was filled in at the end of the day.
- Lake Louise (LL): a questionnaire for acute mountain sickness symptoms also fulfilled at the end of the day (LL score).

Statistics

Differences within scores throughout the study were tested by ANOVA and post-hoc Bonferroni. Pearson's linear correlation coefficients (r) were used to test association between tests.

Total score of fatigue questionnaire (TSF-10)

Circle (from 1 to 7) which best describes your feeling of fatigue today		No, not at all							Yes, a lot						
1	I found training more difficult than usual	1	2	3	4	5	6	7	1	2	3	4	5	6	7
2	I slept more than usual	1	2	3	4	5	6	7	1	2	3	4	5	6	7
3	My legs felt heavy	1	2	3	4	5	6	7	1	2	3	4	5	6	7
4	My arms and shoulders felt heavy	1	2	3	4	5	6	7	1	2	3	4	5	6	7
5	I caught cold / flu / infection	1	2	3	4	5	6	7	1	2	3	4	5	6	7
6	My concentration was poorer than usual	1	2	3	4	5	6	7	1	2	3	4	5	6	7
7	I worked less efficiently than usual	1	2	3	4	5	6	7	1	2	3	4	5	6	7
8	I felt more anxious or irritable than usual	1	2	3	4	5	6	7	1	2	3	4	5	6	7
9	My appetite was poorer than usual	1	2	3	4	5	6	7	1	2	3	4	5	6	7
10	I had more stress at home, school, training, work	1	2	3	4	5	6	7	1	2	3	4	5	6	7

Results

- Data were obtained from 673 questionnaires and 1,350 sessions.
- TSF8 and TSF10 questionnaires were highly correlated ($r=0.97$, $p<0.001$).
- Both additional TSF-10 items were moderate associated with LL score (item 4: $r=0.34$; item 9: $r=0.22$) ($p<0.001$).

Table 1. Comparison of the questionnaires values throughout the study

	Wk 1	Wk 2	Wk 3
s-RPEw	4.57 ± 1.90	5.30 ± 1.77 ^{a,c}	4.80 ± 1.99 ^b
LL score	2.02 ± 1.6	1.83 ± 1.6 ^a	1.61 ± 1.6 ^a
TSF-8	18.0 ± 5.9	16.9 ± 5.3 ^a	16.6 ± 6.6 ^a
TSF-10	23.2 ± 7.0	22.3 ± 6.4 ^a	21.7 ± 8.0 ^a

a= different from Wk 1; b= different from Wk 2; c= different from Wk 3 ($p<0.05$)

Table 2. Correlations between LL score and both TSF (8 and 10 items)

		Wk 1		Wk 2		Wk 3		Total	
		TSF-8	TSF-10	TSF-8	TSF-10	TSF-8	TSF-10	TSF-8	TSF-10
LL score	n	230	230	233	233	207	207	670	670
	r	0.395	0.515	0.403	0.437	0.571	0.596	0.461	0.488
	p	<0.001							

Discussion

TSF scores may serve to identify some of the potential negative effects of training under hypoxic conditions on performance or health state that are often linked to altitude sickness (Calderón et al., 2011).

The high correlation between TSF-8 and TSF-10 questionnaires indicate that both are equally valid tools for assessing training stress and fatigue during AT.

The link observed between LL score and the two news items (tiredness of arms and appetite) could justify the stronger association between LL score and TSF-10.

Conclusions

- The extended version of the total fatigue score (TSF-10) is equally valid than TSF-8 and more appropriate in elite swimmers when training in hypoxic conditions**
- The combination between LL questionnaire for hypoxia-related health disturbances and TSF-10 can be considered a useful approach to assess well being and fatigue in elite swimming athletes training at altitude/hypoxia**



References

Atlaoui et al. (2004). Med Sci Sports Exerc, 36(2), 218-224.
 Foster et al. (2001). J Strength Cond Res, 15, 109-115.
 Calderón et al. (2011) 16th ECSS Annual Congress, Liverpool.

