

The Profile of Mood State (POMS) questionnaire as an indicator of Overtraining Syndrome (OTS) in endurance athletes

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Abstract

The overtraining syndrome (OTS) is largely a diagnosis of exclusion. The aim of this study was to investigate the compact Profile of Mood State (POMS) questionnaire as an early and accurate indicator for the diagnosis of OTS and the reliability of such findings in a group of athletes diagnosed with OTS, in comparison with a non-OTS (NOTS) group. Athletes were from athletic clubs in Gauteng, South Africa. The study population included 10 endurance athletes who completed the compact version of the POMS test which is based on 65 questions using a 4-point adjective rating scale which measure 6 identifiable moods of affect states: tension-anxiety; depression-dejection; anger-hostility; vigour-activity; fatigue-inertia; and confusion-bewilderment. Anger, vigor and fatigue all reflected p values < 0.0001, thus showing reliability in predicting OTS. The study showed significant differences in mood states between the OTS and the NOTS group. Only tension was similar in both groups. The POMS test was found to be a promising tool in the early diagnosis of OTS.

Keywords: Overtraining syndrome, diagnosis, Profile of Mood State questionnaire.

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Introduction

The Olympic motto *citius, altius, fortius* (faster, higher, stronger) epitomizes the goal of athletic training (Robson-Ansley & Smith, 2006). As athletes strive to improve their performance, inevitably their training load increases (Robson-Ansley *et al.*, 2006). Frequently, their training strategies are successful and their performance improves. However, when prolonged excessive training stresses are applied concurrent with inadequate recovery, performance decrements and chronic maladaptations occur. Known as the Overtraining Syndrome (OTS), this complex condition afflicts a large percentage of athletes at least once during their careers

(Armstrong & Van Heest, 2002). Armstrong and Van Heest (2002) proposed that OTS and major depression (MD) have similar aetiologies. Overload refers to a planned, systematic, progressive increase in training stimuli that is required for improvements in strength, power and endurance. Over-reaching refers to training that involves a brief period of overload, with inadequate recovery that exceeds the athlete's adaptive capacity. Overtraining exceeds overreaching and results in frank physiological maladaptations and chronically reduced exercise performance (Armstrong & Van Heest, 2002).

Signs and symptoms of OTS

Fry, Morton and Keast (1991) have listed over 90 signs and symptoms in their 1991 review of OTS. Selected signs and symptoms as described in the published review article by Robson-Ansley *et al.* (2006), are the following: decreased physical performance, general fatigue, malaise, loss of vigour, insomnia, change in appetite and mood, loss of bodyweight, loss of motivation, lack of mental concentration and feelings of depression.

The above symptoms may also be associated with the diagnosis of clinical depression and could be the underlying cause of OTS and the use of antidepressants to treat OTS may be recommended (Armstrong & Van Heest, 2002). It is, therefore, ironic that whilst physical activity may play an important role in the management of mild to moderate depression, excessive physical activity may lead to overtraining and generate psychological symptoms that mimic depression (Paluska & Schwenk, 2000).

Tools for diagnosing OTS

OTS is largely a diagnosis of exclusion (Nederhof, 2008). Organic diseases that may mimic the symptoms of OTS must be excluded first (Urhausen & Kindermann, 2002). These diseases include hypothyroidism, renal failure, major depression, anaemia, nutritional deficiencies, connective tissue diseases, diabetes mellitus, drugs, paroxysmal atrial tachycardia, muscular dystrophies, stress, Cushing's disease and tissue trauma. Tools to diagnose OTS may be used at rest or during exercise. There is no gold standard test to diagnose OTS, thus early and unequivocal recognition of OTS is virtually impossible because the only certain sign is a plateau or decrease in performance during competition and training (Armstrong & Van Heest, 2002).

Tools for diagnosing OTS at rest

Several tests are currently proposed to test for OTS in athletes. Increases in resting heart rate are a known sign of OTS (Urhausen & Kindermann, 2002). Testing the mood state of athletes with a questionnaire has also been suggested. Here the profile

of mood state (POMS) questionnaire is regarded as a promising tool. It is known that the physical demands of overtraining are not the only elements in the development of OTS (Armstrong & Van Heest, 2002). A complex set of psychological factors are important in the development of OTS, including excessive expectations from a coach and family, competitive stress, personality structure, social environment, relations with family and friends, monotony in training, personal and emotional problems, and school or work related demands (Armstrong & Van Heest, 2002). The POMS questionnaire assesses tension, depression, anger, vigour, fatigue and confusion (Mc Nair, D.M., Lorr, M. & Droppelman LF, 1992; Prapavessis, 2000).

Blood tests including enzyme activities and metabolic markers, for example, Creatinine kinase (CK), urea, uric acid and ammonia may be used to test for OTS (Rietjens, Kuipers, Adam, Saris, van Breda, van Hamont & Keizer, 2005). Hormone testing, for example, catecholamines and testosterone, including the testosterone/cortisol ratio (Brukner & Khan, 2006) is also suggested in literature for OTS testing. A decrease in Glutamine in peripheral blood was also reported in over trained athletes (Urhausen & Kindermann, 2002).

Methods and Material

Study Sample

The study sample included 10 endurance athletes who were diagnosed with OTS, and 19 athletes without signs and symptoms of OTS. The athletes were from the High Performance Centre (UP) and various athletic clubs in Gauteng, South Africa. Patients included in the study were endurance athletes diagnosed with OTS by a sports medicine physician. The diagnosis was based on patient history, ruling out other diseases, and the presence of some OTS symptoms. These symptoms included: low-grade psychological and psychosomatic symptoms (e.g. anger, fatigue, tension, loss of appetite); short-term sleeping problems; muscle fatigue; immunologic or hormonal disturbances such as menstrual irregularities; more severe symptoms such as depression, severe long-term insomnia, long-term muscle soreness, or abnormal sense perceptions; a feeling of unwillingness to train and of inability to go on training; and, most importantly, decreased level of performance. This study was conducted over a specific time during the recovery period after OTS was diagnosed. The results were statistically evaluated to develop a diagnostic tool for OTS.

The primary aim of the study was thus to determine if there was a statistical difference in the results obtained from the POMS questionnaire completed by the OTS group athletes and those obtained from the NOTS athletes (*i.e.* the athletes without any signs and symptoms of OTS).

The profile of mood state questionnaire

Research has shown that the mood state of over trained athletes may be influenced (Armstrong & Van Heest, 2002). For this reason a validated questionnaire: “The compact POMS” (Profile of Mood State), was included in this study to determine if the affective state of over trained athletes differ from normal athletes. The questionnaire was completed by all participants on three consecutive mornings. The average mark was calculated and used to determine if significant differences exist between athletes diagnosed with overtraining syndrome and normal athletes (NOTS, *i.e.* the athletes without any signs and symptoms of OTS).

Research data acquired by Dr J Swartz (Director of the University hospital Psychiatric Clinic), Boston University Medical Centre, indicated a need for an easy to implement and swift method to identify fluctuating affective states. With this in mind a “factor analytically derived inventory was developed” and used as part of a standard assessment program in the psychiatric clinic. It was called “the Profile of Mood States (POMS) (McNair, Lorr & Droppelman, 1971). The POMS questionnaire is based on 65 questions, using a 4-point adjective rating scale, which measures 6 identifiable moods or affect states: Tension-anxiety; depression-dejection; anger-hostility; vigour-activity; fatigue-inertia and confusion-bewilderment (McNair, Lorr & Droppelman, 1971; Armstrong & Van Heest, 2002).

Since it was developed in 1971, the POMS-test was proven to measure variable affective states in diverse situations. It is a sensitive indicator of the responses of patients to various therapeutic approaches. The brevity of the questionnaire also means that it provides an instrument for assessing mood changes in a variety of settings, including non-psychiatric populations, like team sports, military training as well as individual athletes, whether it be on or off the participation area (McNair, Lorr & Droppelman, 1971; Armstrong & Van Heest, 2002).

All the questionnaires were hand scored. A value for each mood/affect indicator (Tension-anxiety; depression-dejection; anger-hostility; vigour-activity; fatigue-inertia and confusion-bewilderment) was determined by the sum of all the adjectives defining this factor. All items for each indicator were keyed in the same direction except for “Relaxed” (Tension-Anxiety indicator) and “Efficient” (Confusion indicator). These received negative weights in calculating the indicator scores.

Ethical Considerations

The Faculty of Health Sciences Research Ethics Committee at the University of Pretoria approved the protocol. Participation was voluntary and informed consent was obtained prior to the study. To standardize the conditions, participants were asked to refrain from exercise, alcohol and caffeine ingestion 24 hours prior to the

trial. Pre-printed questionnaires of the POMS test were given to all participants to complete. This was a compact version of the POMS, which is based on 65 questions using a 4-point adjective rating scale that measures 6 identifiable moods of affect states. Consultation with potential participants took place over a period of 3 months.

Study exclusion criteria

Exclusion criteria included pregnancy, pace makers, renal failure, diabetes mellitus, organic pathology or physical injury resulting in compromised exercise ability, minors, ischaemic heart disease, hypothyroidism, nutritional deficiencies, anaemia, cushing's disease, muscular dystrophies and tissue trauma.

Statistical analysis

The OTS and NOTS groups were compared through a univariate procedure in order to establish relations and differences in mean values. The Mann-Whitney method was used to compare the two groups. Pearson Correlation Coefficients were calculated to determine relationships between the subscale measurements of the POMS test. A stepwise discriminant analysis was performed to select those POMS variables which discriminate best between the OTS and NOTS groups. The combination of variables which best predicts the group to which an individual belongs was found. The Discriminant analysis calculates a classification or discriminant function which is determined by a measure of generalised squared distance between the OTS and NOTS groups. This function can then be used to classify new cases whose group membership is unknown. The procedure assumes that for each group, the set of POMS variables has a multivariate normal distribution with a common covariance matrix.

Results and Discussion

The athletes' demographic data is represented in Table 1. The mean age of the participants ranged between 27 and 29 years of age. The mean BMI was below 25 kg/m².

Table 1: Demographic data

Variable	OTS mean	SD	NOTS	SD
Weight (kg)	73.12	17.96	63.54	10.35
Height (cm)	176.24	9.05	171.68	8.20
Age (years)	27.85	7.19	29.51	5.38
BMI (kg.m ²)	24.13	3.46	21.09	2.10

OTS: Over training Syndrome group; NOTS: Healthy group; SD: Standard deviation

Experimental Data

POMS subscale values for OTS and NOTS groups are shown in Table 2

Table 2: Mean values, standard deviation and coefficient of the variations for OTS and NOTS Groups

Variable	Mean		Standard Deviations		Coefficients of Variation	
	OTS	NOTS	OTS	NOTS	OTS	NOTS
Tension	2.20	1.21	1.32	1.08	0.59	0.89
Depression	2.00	0.37	1.15	0.60	0.57	1.62
Anger	2.00	0.26	0.67	0.45	0.33	1.71
Vigour	2.80	9.21	0.63	2.02	0.22	0.21
Fatigue	4.10	0.53	1.29	0.61	0.31	1.16
Confusion	1.80	0.42	1.69	0.61	0.93	1.44

OTS: Over training Syndrome group; NOTS: Healthy group

Among the subscales, vigour had the highest score (NOTS) and was inversely proportional to anger. In Table 2, fatigue had the highest score in the OTS group, which is one of the presenting signs of OTS, while in the NOTS group, vigour showed a peak which correlates with a better outcome in competition. The other emotions - tension, depression, anger, vigour and confusion - had similar scores in the OTS group, whereas in the NOTS group, tension had a higher value than depression, anger, fatigue and confusion.

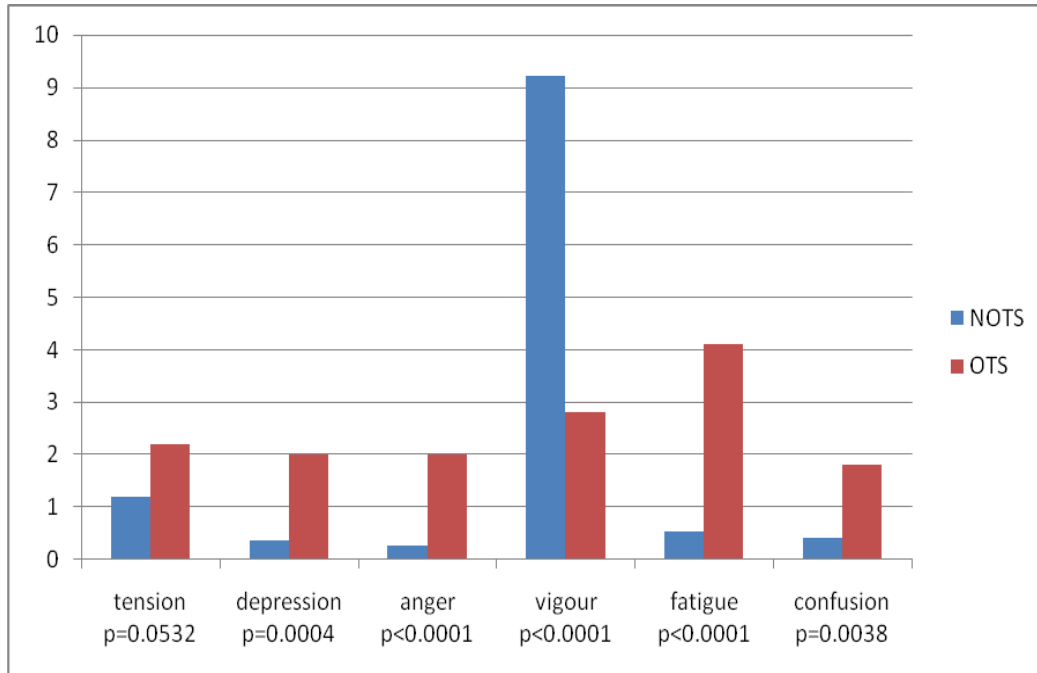


Figure 1: Descriptive analysis of mean values between OTS (over training syndrome group) and NOTS (healthy) groups

Of significance is the result that anger and fatigue have a negative correlation with vigour and are positively related to depression (Table 3).

Table 3: Pearson Correlation Coefficients for different POMS subscales

Subscale	Tension	Depression	Anger	Vigour	Fatigue	Confusion
Tension Correlation	1.00	0.13	0.30	-0.33	0.41	0.38
p-value		5.025	0.1183	0.0831	0.0259*	0.0425*
Depression Correlation	0.13	1.00	0.79	-0.57	0.48	0.24
p-value	0.5025		<.0001*	0.0011*	0.0084*	0.2009
Anger Correlation	0.30	0.79	1.00	-0.75	0.65	0.36
p-value	0.1183	<.0001*		<.0001*	0.0001*	0.0555
Vigour Correlation	-0.33	-0.57	-0.75	1.00	-0.76	-0.51
p-value	0.0831	0.0011*	<0.0001		<.0001*	0.0043*
Fatigue Correlation	0.41	0.48	0.65	-0.76	1.00	0.62
p-value	0.0259*	0.0084*	0.0001*	<.0001*		0.0004*
Confusion Correlation	0.38	0.24	0.36	-0.51	0.62	1.00
p-value	0.0425*	0.2009	0.0555	0.0043*	0.0004*	

* : p<0.05; OTS: Over training Syndrome group; NOTS: Healthy group

The values calculated for the discriminant coefficients of the linear discriminant functions are shown in Table 4. Anger, vigour and fatigue in both groups were not closely related and would, therefore, be good predictors of OTS (Table 4).

Table 4: The discriminant coefficients of the linear discriminant functions

Variable	OTS	NOTS
Anger	13.23	1.08
Vigour	0.43	3.23
Fatigue	8.46	0.18
Constant	-31.87	-15.75

OTS: Over training Syndrome group; NOTS: Healthy group

In the present study, the POMS questionnaire was used to compare the profiles of the OTS group (diagnosed with OTS by specific criteria set by a multi-disciplinary team) with those of the NOTS (normal athletes). Few studies have focused on the OTS versus NOTS, hence the need for a study of this nature.

The mean values obtained for the two groups for the six indicators are presented in Figure 1 and Table 2. Statistically significant differences between the groups on the 5% level were found for all the indicators except tension (Figure 1). The indicators anger, vigour and fatigue were identified as the most influential variables to determine the group to which an individual belongs (Wilk’s lambda=0.05665, approximate F-statistic = 138.771). Shown in Table 4, discriminant coefficients of

the linear discriminant functions were calculated for anger, vigour and fatigue as they were the most influential variables. This resulted in set values that can be used as a constant in an equation to calculate probability to a group. A new individual will be classified in the group with the largest value of the discriminant function.

An impaired mood state and subjective complaints are consistently described as sensitive and early markers of OTS (Prapavessis, 2000; Armstrong & Van Heest, 2002). The most fruitful measurements have been of mood, evaluated by the POMS test (Armstrong & Van Heest, 2002). The deterioration in mood state usually starts well before the definitive drop in performance and parallels the increase in training load. The subjective complaints are dominated by a pronounced feeling of muscular soreness ('heavy legs' in runners, tri-athletes and cyclists), which usually occurs during low exercise intensities and daily activities. Sleep disorders may also be an early indicator warning sign of OTS (Armstrong & Van Heest, 2002).

The ability to produce and maintain appropriate emotional feelings before competition is universally recognized by athletes and coaches as one of the most important factors contributing to athletic performance (Prapavessis, 2000). The conceptual approach, primarily through Morgan et al's (1987) Mental Health Model (MHM), proposes that positive mental health (i.e. emotional) and successful athletic performance is strongly correlated. Athletes who are less anxious, angry, depressed, confused and fatigued, and more vigorous, will be more successful than athletes who exhibit the opposite profile, as assessed by POMS (Mc Nair et al, 1992). Most of the studies have concentrated on this aspect.

The positive profile of mood states has been termed the iceberg profile by Morgan et al. (2007) since five negative mood states fall below the population norms and the one positive mood lies above it (Prapavessis, 2000). The ease with which changes in mood state may be measured as compared to the majority of physiological markers previously used, encourages monitoring of athletes (Pierce, 2002).

Rietjens, et al. (2005) found that cognitive function is the first and most sensitive parameter for detecting over reaching and that reaction time values (indicative of cognitive functioning), combined with POMS (indicative of mood state) and rate of perceived exertion (useful for calculating the subjective training load), enable the athlete and his coach to prevent over reaching and over training.

There appears to be individual variability in the threshold of training leading to OTS. Daily monitoring of self-analysis measures, such as the athlete's perception of training adaptation, stress levels, fatigue, and quality of sleep and muscle soreness, may be effective in identifying susceptible athletes before the appearance of other symptoms (MacKinnon, 2000). Once OTS has set in, however, a modified POMS

questionnaire can be used to diagnose the condition and changes made to the training schedule, with a period of recovery.

Morgan (Morgan, et al., 1987) used the POMS questionnaire at the pre-competition phase to predict the outcome of sports performance. The researchers used the POMS questionnaire for athletes already showing symptoms of OTS to assess whether it is reliable in diagnosing OTS, as compared to NOTS athletes. Some studies (Morgan, et al., 1987) found a typical 'iceberg' profile with a peak in vigour in those athletes who were predicted to have a positive outcome in competition. As seen in Figure 1, the NOTS groups of athletes have a typical 'iceberg' profile with a peak in vigour.

In contrast, the OTS athletes have a peak in fatigue which is one of the presenting symptoms of OTS and a dip in vigour - a typically inverse 'iceberg' profile (Figure 1). This correlates with poorer outcome in competition. The values for tension of both groups were the most closely related and would, therefore, be a poor prediction of athletic performance. Since these are not professional athletes, other factors such as work, socio-economic circumstances and family stressors could have confounded this finding. Although depression had a higher score in OTS, this could be related to the individual's personal bio-psychosocial factors that could affect his mood state at the time and would affect his sport performance.

Anger, vigour and fatigue had p-values of <0.0001 , indicating significant differences between the two groups. Significant higher anger and fatigue feelings were accompanied by lower vigour in the athletes diagnosed with OTS. Of interest is the result that anger and fatigue have a negative relation with vigour, as seen on Table 3, giving a p-value of <0.001 and positively relationship with depression. These subscales may thus be used as objective tools to distinguish between OTS and NOTS athletes.

This study, using the POMS questionnaire to diagnose OTS, had similar results compared to other studies (Fry, Morton & Keast, 1991; Fry, Grove, Morton, Zeroni, Gaudieri & Keast, 1994; Prapavessis, 2000; Urhausen & Kindermann, 2002; Pierce, 2002; Filiare, Legrand, Lac & Pequignot, 2004). Kentta, Hassmen and Raglin (2001) reported that the incidence of OTS was higher in individual rather than team sports.

Conclusion

The modified POMS questionnaire may be used to detect early signs of OTS in susceptible individuals. Its use is not restricted to athletes, but is also applicable to subjects who are expected to carry out other physically strenuous activities, such as military personnel.

A study with a larger number of participants would have greater reliability and credibility. Repetition of the POMS questionnaire in OTS after a recovery period, with changes in the reading, would substantiate the findings. A list of culturally appropriate adjectives should be included to explain the POMS items. This will aid against language as a possible confounder when using POMS among people of diverse cultural, ethnic and racial populations (Prapavessis, 2000).

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