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.

DOES OVERTRAINING OCCUR IN TRIATHLETES?

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This study has been presented in the First Annual Congress of the European College of Sport Science, May 28-31, 1996, Nice, France

Abstract. *1. Objective*: Long distance triathlon training is characterized by considerably high volume training loads. This volume can provoke an overtraining state. The aim of the study was to determine whether overtraining occurs in well-trained male triathletes in relation with their volume training loads. *2. Experimental design*: A questionnaire investigation was completed two days before the Nice long-distance triathlon (October 1995: 4-km swim, 120-km bike ride and 30-km run). *3. Participants*: Ninety-three well-trained male triathletes who took part in the triathlon race. *4. Measures*: A questionnaire to relate clinical symptoms, which are known to appear in case of overtraining, was collected. *5. Results*: 39.8% of the questioned triathletes reported a decrease in triathlon performances within the last month preceding the race. Moreover, these triathletes exhibited significantly more overtraining-relied symptoms than the others (5.9±3.8 *vs* 3.4±2.6, $P<0.05$). Surprisingly, the occurrence of overtraining in triathletes appears not to depend on the volume training loads. *6. Conclusions*: These results suggest that overtraining has to be considered in the case of triathletes. This preliminary study evidences the need for further investigation in order to monitor triathletes training respond and prevent overtraining.

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Key words: Overtraining - Triathlon - Clinical signs - Weekly volume training loads

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Introduction

Triathlon is a multievent sport which involves three events (swimming, cycling, running) done sequentially. Long duration triathlons induce physiological stress because of the high volume of work to be done. This is the reason why long distance triathlon training is characterized by considerably high volume training loads. This volume can provoke overreaching and/or overtraining. Overtraining is defined as a decreased performance capacity despite an increase or a maintenance of training loads which is associated to either physiological or psychological disturbances [8]. Psychological and behavioral disturbances are the expression of the primary physiological stress induced by the repeated bouts of long duration exercises.

Numerous studies are presented cases of overreaching and/or overtraining in swimming [7,9], cycling [11] and running [15]. But up-to-date no data is available about overtraining occurrence in endurance triathletes [17].

Several clinical symptoms have been found to be the consequence of these disturbances, which can be assessed by biochemical methods. The clinical diagnosis of some physiological and/or psychological symptoms is sufficient to suppose an overreaching and/or overtraining state. The monitoring of the clinical symptoms is proposed in the present study as a non-invasive method used to evidence overtraining occurrence in triathletes. The aim of the study was to determine whether overtraining occurs in well-trained male triathletes in relation with volume training loads.

Materials and Methods

Subjects: 93 well-trained male triathletes (age: 29±4.9 years; height: 179.0±5.7 cm; body mass: 70.7±5.7 kg; $\dot{V}O_2$ max: 68.7±5.8 $ml.min^{-1}.kg^{-1}$) who took part in the Nice long-distance triathlon (October 1995: 4-km swim, 120-km bike ride and 30-km run) volunteered to participate in this study. They trained an average of 15 h 54 min ± 5 h 12 min per week, divided into 9.7±2.5 sessions per week. The mean finish time was 7 h 42 min ± 42 min.

Procedures: The questionnaire included 25 questions relevant to clinical symptoms (physiological or psychological) which are known to appear in some case of overreaching or overtraining (Table 1). The triathletes have to complete the questionnaire two days before the race. They could only answer *yes* or *no*. One point was counted at each clinical sign of overtraining observed by the triathlete himself. The number of points was totaled for each subject.

Table 1
Clinical symptoms of overtraining in the present study

Symptoms	**References**
Decreased performance capacity	1, 4, 7, 9, 11, 15, 20
Fatigue	4, 9, 18
Increased aches and pains	9, 20
Injury	13
Increased heart rate at rest	11, 20
Decreased heart rate at rest	10, 15
Recovery prolonged	8, 10
Sleep disturbances	9, 18, 20, 22
Loss of appetite	8, 22
Weight loss	22
Gastrointestinal disturbances	20
Decrease in sexual libido	5, 22
Respiratory infections	2, 16, 19, 20
Herpes	2
Headaches, nausea, dizziness	8
Hypoglycemia during exercise	14
Memory disturbances	3
Increased internal distractibility	8, 18
Withdrawal into oneself	21
Anxiety	21, 22
Fear of competition	8
Irritability	20, 22
Loss of training desire	9, 22
Decreased toleration of loading	4, 18
Lack of will	1, 7

Furthermore, the triathletes had to report their weekly training loads in each of the three events (Table 2) and the number of long duration triathlon competitions completed in the season.

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Table 2
Weekly training loads (means ±SD)

	Swim	Bike	Run
Distance (km)	8.6±3.7	256.2±99.9	47.7±18.8
Time (h)	3.5±1.3	8.6±3.3	4.0±1.8
Total volume (% total time)	22.1±0.1	53.0±0.1	24.9±0.1

Statistical analysis: The population was divided into two groups (G) according to whether their performances had decreased within the last month (G_1; N=37) or not (G_0; N=56). A non-parametric t-test was performed to test whether the scores (S) were higher than the theoretical value chosen (S'=3). A correlation analysis (ρ Spearman) was used to indicate relationships between the training loads according to energetic expenditure, scores, and performances. A one-way ANOVA was performed to compare the scores and the weekly training loads between G_1 and G_0. A Chi square analysis (χ^2) was used to compare the scores for each clinical sign of overtraining reported by G_1 and G_0. Statistical significance level was set at $P<0.05$.

Results

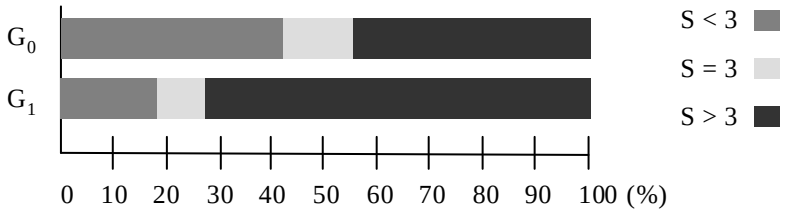

Fig. 1
Scores (S) for the 93 triathletes (in % frequency for each group) under and above the level set at S=3. Data are presented for both groups: with (Group 1: G_1; N=37) or without (Group 0: G_0; N=56) decreased performances within the last month

39.8% of the questioned triathletes reported a decrease in triathlon performances within the last month preceding the race. This group has been identified in the study as G_1. G_1 scores were significantly higher than G_0 scores (5.9±3.8 *vs* 3.4±2.6, P<0.05) (Fig. 1). The scores were neither correlated with total training loads nor with the Nice Long Distance Triathlon performance. However, the number of long duration triathlon completed by G_1 in the season was significantly higher than G_0 (1.9±0.7 *vs* 1.1±0.3; P<0.05).

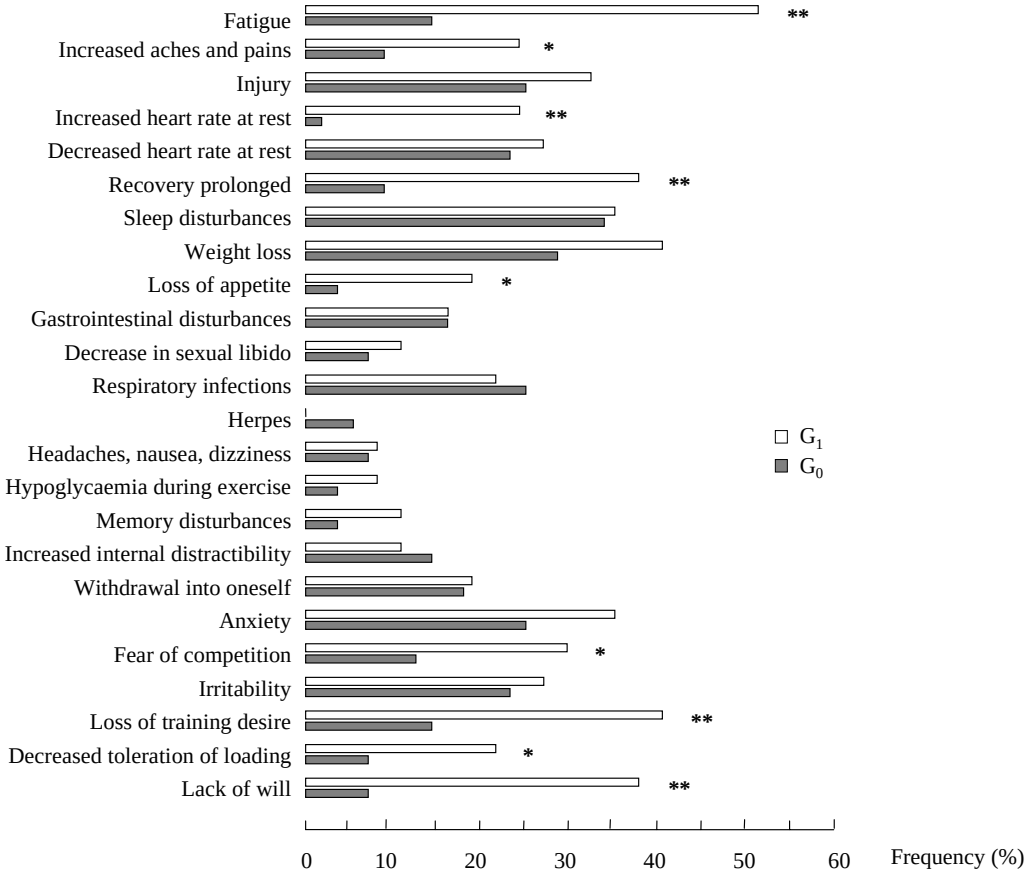

Fig. 2

Reported clinical signs of overtraining (in % frequency reported for each sign) for both groups: with (Group 1: G_1; N=37) or without (Group 0: G_0; N=56) decreased performances within the last month

*****Significance level at P<0.05; ******P<0.01

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The training loads did not differ between G_1 and G_0. The symptoms reported were widely scattered among the proposed symptoms (Fig. 2).

Discussion and Conclusions

Long distance triathlon training can require a large volume of training at high intensity. If this specific work is associated with little recovery between the training sessions, the risk of overtraining is characterized, among other things, by disturbances in the mood state [22] and the accumulative effect of fatigue increase. The border between adaptation training and a functional impairment due to overtraining is fluid [10,14]. The high proportion of triathletes (39.8%) who reported recent decreased performances indicates that triathlon training can induce overtraining. This observation is confirmed on one hand by the differences evidenced between these triathletes scores and the others, on the other hand by the high scores of this group. It appears that the decrease in performance is accompanied by an increase in clinical signs of physiological and/or psychological disturbances (Fig. 2). The fact that G_1 exhibited significantly more overtraining-relied symptoms than G_0 evidences the usefulness of the psychological and behavioral monitoring in order to prevent overtraining and consequently the decrease in performance. Surprisingly, in our study, the occurrence of overtraining in triathletes appears not to depend on the training load volume as it has been proposed for endurance running [15]. The intensity of the training, which appear to be very stressful to the organism, could have been for a larger part than the volume, contributing, in inducing overtraining [8]. Moreover, sudden increases in training loads in triathletes and inappropriate training compromising recovery may induce overtraining. Incomplete recovery may be observed in triathletes, because with daily training in two or three disciplines an imbalance between training sessions and recovery may easily occur and induce overtraining. Other factors contributing to overtraining include other demands such as problems in human relations, environment, profession, incorrect eating habits, sleeplessness, and various inflammations [6,8,10,12,14]. The significance of such factors can increase when training is very intensive [8]. Consequently, psychological and/or sociological factors have probably to be taken into account in the etiology of overtraining.

We conclude that overtraining has to be considered in the case of triathletes. This preliminary study evidences the need for further investigation including biochemical assessment in order to monitor triathletes training response and prevent overtraining.

References

1. Barron J.L., T.D.Noakes, W.Levy, C.Smith, R.P.Millar (1985) Hypothalamic dysfunction in overtrained athletes. *J.Clin.Endocrinol.Metab.* 60:803-806

2. Brenner I.K.M., P.N.Shek, R.J.Shepard (1994) Infection in athletes. *Sports Med.* 17:86-107

3. Brun J.F., O.Bouix, C.Fédou, M.El Kamar, A.Orsetti (1993) Subjective overtraining signs analysis in Tae Kwon Do. *Sci.Sport* 8:17-20 (in French)

4. Costill D.L., M.G.Flynn, J.P.Kirwan, J.A.Houmard, J.B.Mitchell, R.Thomas, S.Han Park (1988) Effects of repeated days of intensified training on muscle glycogen and swimming performance. *Med.Sci.Sports Exerc.* 20:249-254

5. De Souza M.J., J.C.Arce, L.S.Pescatello, H.S.Scherzer, A.A.Luciano (1994) Gonadal hormones and semen quality in male runners: A volume threshold effect of endurance training. *Int.J.Sports Med.* 15:383-391

6. Eichner E.R. (1995) Overtraining: Consequences and prevention. *J.Sports Sci.* 13:S41-S48.

7. Flynn M.G., F.X.Pizza, J.B.Boone Jr, F.F.Andres, T.A.Michaud, J.R.Rodriguez-Zayas (1994) Indices of training stress during competitive running and swimming seasons. *Int.J.Sports Med.* 15:21-26

8. Fry R.W., A.R.Morton, D.Keast (1991) Overtraining in athletes: An update. *Sports Med.* 12:32-65

9. Hooper S.L., L.T.Mackinnon, R.D.Gordon, A.W.Bachmann (1993) Hormonal responses of elite swimmers to overtraining. *Med.Sci.Sports Exerc.* 25:741-747

10. Israel V.S. (1976) Zur problematik des ubertrainings aus internistischer und leistungsphysiologischer sicht. *Med.u.Sport* 16:1-12 (in German, English abstract)

11. Jeukendrup A.E., M.K.C.Hesselink, A.C.Snyder, H.Kuipers, H.A.Keizer (1992) Physiological changes in male competitive cyclists after two weeks of intensified training. *Int.J.Sports Med.* 13:534-541

12. Kirwan J.P., D.L.Costill, J.B.Mitchell, J.A.Houmard, M.G.Flynn, W.J.Fink, J.D.Beltz (1988) Carbohydrate balance in competitive runners during successive days of intense training. *J.Appl.Physiol.* 65:2601-2606

13. Korkia P.K., D.S.Tunstall-Pedoe, N.Maffulli (1994) An epidemiological investigation of training and injury patterns in british triathletes. *Br.J.Sports Med.* 28: 191-196

14. Kuipers H., H.A.Keizer (1988) Overtraining in elite athletes: Review and directions for the future. *Sports Med.* 6:79-92

15. Lehmann M., P.Baumgartl, C.Wiesenack, A.Seidel, H.Baumann, S.Fischer, U.Spori, G.Gendrisch, R.Kaminski, J.Keul (1992) Training-overtraining: influence of a defined increase in training volume vs training intensity on performance, catecholamines and some metabolic parameters in experienced middle- and long-distance runners. *Eur.J.Appl.Physiol.* 64:169-177

16. Mackinnon L.T. S.L.Hooper (1994) Mucosal (secretory) immune system responses to exercise of varying intensity and during overtraining. *Int.J.Sports Med.* 15:S179-S183

17. Margaritis I. (1996) Factors limiting performance in the triathlon. *Can.J.Appl. Physiol.* 21:1-15 (in French, English abstract)

18. Morgan W.P., D.L.Costill, M.G.Flynn, J.S.Raglin, P.J.O'Connor (1988) Mood disturbane following increased training in swimmers. *Med.Sci.Sports Exerc.* 20:408-414

19. Nieman D.C. (1994) Exercise, infection, and immunity. *Int.J.Sports Med.* 15: S131-S141

20. Parry-Billings M., R.Budgett, Y.Koutedakis, E.Blomstrand, S.Brooks, C.Williams, P.C.Calder, S.Pilling, R.Baigrie, E.A.Newsholme (1992) Plasma amino acid concentrations in the overtraining syndrome: Possible effects on the immune system. *Med.Sci.Sports Exerc.* 24:1353-1358

21. Raglin J.S. (1990) Exercise and mental health. Beneficial and detrimental effects. *Sports Med.* 9:323-329

22. Veale D.M.W. (1991) Psychological aspects of staleness and dependence on exercise. *Int.J.Sports Med.* 12:S19-S22

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