The time limit of maintaining the running speed at VO_2max (T_{LIM} VO_2max). A comparative study between trained and untrained

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Abstract

Specialised literature is very rich in means evaluating of VAM or vVO_2max and methods of increasing this physical ability, yet poorer in assessing the limit time of maintaining it ($t_{lim}VO_2max$). $t_{lim}VO_2max$ is the running time that an athlete can maintain at VAM. This study assumes that it is possible that trained individuals achieve a $t_{lim}VO_2max$ greater than untrained individuals. 14 male persons were involved in this study; they were divided into two groups: trained and untrained. VAM evaluation was done by using the VAMEVAL test. The evaluation of $t_{lim}VO_2max$ was done by using the VAMEVAL soft. The results of the study refute the research hypothesis, Group B, that was made up of subjects with a lower VO_2max, obtained an average $t_{lim}VO_2max$ better than group A, group that consists of athletes and better VO_2max subjects.

Key words: *vVO_2max, $t_{lim}VO_2max$, trained, untrained*

Rezumat

Literatura de specialitate este foarte bogată privind modalităţile de evaluare a VAM sau vVO_2max şi metodele de creştere a acestei capacităţi fizice însă mai săracă în aprecieri asupra timpului limită de menţinere a acesteia ($t_{lim}VO_2max$). $t_{lim}VO_2max$ reprezintă timpul de alergare pe care un sportiv îl poate menţine la VAM. Prezentul studiu pleacă de la ipoteza că este posibil ca persoanele antrenate să realizeze un $t_{lim}VO_2max$ mai mare decât persoanele neantrenate. La studiu au participat 14 persoane de gen masculin care au fost împărţite în două grupe: antrenaţi şi neantrenaţi. Evaluarea VAM a fost realizată cu ajutorul testului VAMEVAL. Evaluarea $t_{lim}VO_2max$ a fost realizată cu ajutorul soft-ului VAMEVAL Rezultatele studiului infirmă ipoteza cercetării, Grupa B, cea care a avut în componenţă subiecţi cu un VO_2max mai mic, a obţinut o medie a $t_{lim}VO_2max$ mai bun decât grupa A, grupă care are în componenţă subiecţi mai sportivi şi cu un VO_2max mai bun.

Cuvinte cheie: *vVO_2max, $t_{lim}VO_2max$, antrenaţi, neantrenaţi*

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Introduction

The maximum oxygen use (VO_2max) can be considered as an important indicator of cardiorespiratory aptitude in the endurance effort or, in other words, of the aerobic capacity to effort. (1,8,11)

If in rest VO_2 is almost the same for both trained and untrained individuals (250-300 ml/min), it tends to decrease in the case of the trained ones, in submaximal effort, for the same level of effort. This indicates an improvement in metabolic efficiency and perhaps, in particular, in biomechanical efficiency, trained athletes perform the same move with greater ease and therefore less energy consumption. (2). In addition, body weight may play an important role in improving the making of the movements and in a more effective effort metabolism. (14)

In maximal effort, we refer to maximum oxygen consumption (VO_2max). The increase of VO_2max is considered to be a metabolic adaptation since it involves both the adaptation of the respiratory and cardiovascular and blood system. (2, 13)

The aerobic type of training increases VO_2max value with up to 50%, depending on the intensity, volume and even complexity of the effort, as well as on the training level of the athlete. Thus, in the case of an untrained athlete, the growth percentage of VO_2max will be higher than in the case of an athlete who, through training, has already developed this parameter. (9) VO_2max cannot exceed a certain, biological-hereditary limit no matter how an the extent to which an athlete would train. Most studies show an increase in VO_2max, following a training program between 15 and 25%. (3,4,8,15)

The increase in VO_2max is obvious in nine to ten weeks of training, continuing to go up, but at a slower rate until the biological-hereditary limit. (10)

The maximal aerobic speed (VAM or vVO_2max) represents the running speed at which the athlete reaches VO_2max. and is measured in m/s or km/h. This has been scientifically proven by Leger and Mercier (1983) [6], the following formula showing the correlation between VAM and VO_2max:

$$VO_2max\ (\ ml.kg^{-1}.min^{-1}) = VAM\ (\ km/h\ ) \times 3.5$$

or,

$$VAM\ (km/h\ ) = VO_2max\ (ml.km.min^{-1})/3.5$$

The intensity and volume of training are very important in increasing VO_2max, these two parameters must be carefully correlated in planning, relying on the evaluation of vVO_2max or on the workload in watts, where the athlete reaches the aerobic or anaerobic effort limit. (14) Thus, the intensity of the effort, gradually planned in the training program, must be between 90-130% of vVO_2max (7, 9)

Referring to efforts, we must highlight the importance of knowing $t_{lim}VO_2max$ value (time limit of maintaining the effort to vVO_2max). It is known that $t_{lim}VO_2max$ is in the range of 5-8 minutes. (5, 15)

The thesis of the research paper

Specialised literature is very rich in means evaluating of VAM or vVO_2max and methods of increasing this physical ability, yet poorer in assessing the limit time of maintaining it ($t_{lim}VO_2max$). $t_{lim}VO_2max$ is the running time that an athlete can maintain at VAM. This study assumes that it is possible that trained individuals achieve a $t_{lim}VO_2max$ greater than untrained individuals.

Materials and methods

Basically, the study aims at achieving first the VAM evaluation of a number of 14 male persons, 7 of them being trained in endurance efforts, 7 untrained. In the second part, the study aims at evaluating the $t_{lim}VO_2max$ of the 14 subjects and calculating possible differences in percentages.

14 male subjects perform a field test to assess maximal aerobic speed (VAM). Seven of the subjects perform aerobic workout and exercise regularly, the other seven subjects are people who practice light physical activities from time to time.

The evaluation of the VAM was carried out using the VAMEVAL test (5), while calculating the distances and the running time for the $t_{lim}VO_2max$ evaluation was carried out by using the VAMEVAL soft. (5)

In the second stage, all 14 subjects perform a run at 100% of VAM, each subject having to maintain a running pace as long as possible.

The third stage of the research involved the analysis and interpretation of the results.

The protocol for the VAM evaluation through field test

The VAMEVAL test, designed in 1983 by Professor Luc Leger of the University of Montreal and Professor Georges Cazorla, University of Bordeaux, is a field test that assesses VO_2max and maximal aerobic speed (VAM or VMA). (5)

The subjects of the research

14 male subjects, aged 18 to 35, divided into two groups.

- Group A consists of 7 subjects who practise physical exercise regularly.
- Group B consists of 7 subjects performing light exercise sporadically.

Results and discussions

The following table (table 1) shows some statistical indicators: arithmetic average, amplitude and standard deviation.

One can notice a higher VAM value of about 1 km / h for group A, 15.7 km / h compared to 15 km / h in group B. This indicates a higher aerobic exercising capacity in group A subjects than group subjects. From the point of view of the homogeneity of the two groups, there is a greater homogeneity in the results of group B subjects.

Interestingly, in regard to $t_{lim}VO_2$max, the results obtained from the research are somewhat surprising and contradictory to the hypothesis of the paper. Thus, the arithmetic average of $t_{lim}VO_2$max of group B is higher than that of group A. If we make a simple calculation of the percentage difference between the two arithmetic averages, we record the percentage difference of 1.96% in group B. We also mention that group B subjects are those who practise physical activities less often than those in group A.

Theoretically speaking, the fitter subjects with better VO_2max should have obtained better results in the effort test of $t_{lim}VO_2$max. This did not happen and practically, the subjects with a lower VO_2max obtained a better average of $t_{lim}VO_2$max.

The results obtained in this research with regard to $t_{lim}VO_2$max have been obtained by other authors as well (4, 5, 10, 15) who investigated $t_{lim}VO_2$max. We found no studies to conduct a comparative survey of $t_{lim}VO_2$max in trained and untrained subjects.

For a more accurate and objective interpretation of the results, we believe that monitoring the heart rate during the exercise would have provided important additional data to explain the evolution and the dynamics of the effort as well as the recorded results.

The results obtained after VAM assessment through a field test by the subjects in Group A and the statistical calculation are presented in table 2.

The results obtained after VAM assessment through a field test by the subjects in Group B and the statistical calculation are presented in table 3.

Table 1. Statistics of the results of the two groups

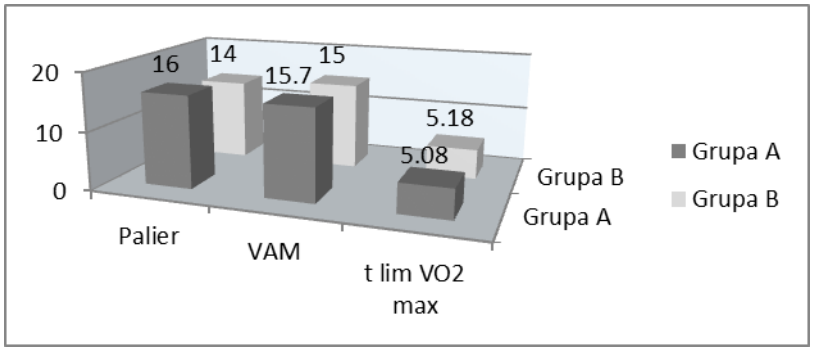
	Levelr		**VAM** (km/h)		**$t_{lim}VO_2$max**	
	Group A	**Group B**	**Group A**	**Group B**	**Group A**	**Group B**
Arithmetic average	16	14	15.7	15	5'08"	5'18"
Amplitude	8	6	3.5	2.5	2'	2'15"
Standard deviation	2.58	2.16	1.1	1.1	0'65"	0'65"

Table 2. The results recorded by group A and statistical indicators

Subject	**Level**	**VAM** (km/h)	**$t_{lim}VO_2$max**
Subject no.1	16	16	5'
Subject no.2	15	15.5	4'30"
Subject no.3	18	17	5'
Subject no.4	11	13.5	5'20"
Subject no.5	17	16.5	6'30"
Subject no.6	16	16	4'45"
Subject no.7	19	17.5	5'30"
Arithmetic average (X)	16	15.7	5'08"
Amplitude	8	3.5	2'
Standard deviation	2.58	1.1	0'65"

Table 3. The results recorded by group B and statistical indicators

Subject	Level	VAM (km/h)	$t_{lim}VO_2max$
Subject no.1	12	14	4'30"
Subject no.2	15	15.5	5'
Subject no.3	13	14.5	5'
Subject no.4	17	16.5	5'20"
Subject no.5	11	13.5	6'45"
Subject no.6	14	15	5'30"
Subject no.7	16	16	5'
Arithmetic average (X)	14	15	5'18"
Amplitude	6	2.5	2'15"
Standard deviation	2.16	1.1	0'65"



Graph 1. The arithmetic average of the results recorded by the two groups

Conclusions

Following the study and the results, we may draw the following conclusions:

Group B, which consists of the subjects with a lower VO_2max, obtained an average a $t_{lim}VO_2max$ better than that of group A group that consists of fitter subjects, with better VO_2max. These results do not confirm the initial hypothesis of this study, namely that it is possible that the trained subjects obtain a higher $tlimVO_2max$ than untrained individuals.

It is possible that a lower vVO2max determine a $tlimVO_2max$ due to greater efficiency of the cardiovascular system as well as better use of O_2 in muscles.

Therefore, we believe that, for a more accurate and objective interpretation of results, monitoring heart rate during exercise in conjunction with an analysis of biochemical indicators and / or O_2 consumption in muscles would have brought us important additional data to explain the evolution and dynamics of effort and the recorded results.

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