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STUDY REGARDING THE INFLUENCE OF HIKING ON THE DEVELOPMENT OF MAXIMAL OXYGEN UPTAKE IN HIGH SCHOOL STUDENTS

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Abstract: *This research aimed to study the effect of hiking on the development of maximal oxygen uptake (VO2 max) in high school students. Starting from the premise that the regular practice of hiking/trekking-type activities has beneficial effects on one's health and motor skills, the author has hypothesized that probably these activities do not have a significant favourable influence on the development of VO2 max. A comparative study was conducted between two groups of subjects, applying a specific program of activities to the experimental group over the course of one academic year. The tests have generated results that led to significant conclusions; at the end of the study, the initial hypothesis was validated.*

Key words: *hiking, VO2 max, high-school students.*

1. Introduction

Hiking is a term that is already commonly used in Romania, representing a mass athletic activity, which was previously known as mountain tourism [4].

This type of activity is called differently in various countries. For example, in France it is called “randonne pedestre”, in the United States, “hiking”, “trekking”, “backpacking”, in the United Kingdom, “walking”, “hiking”, “rambling”, in Germany “bergwandern”, etc [1].

It is thought to be created at the beginning of the 19th century, the first hikers being the British, inhabitants of the most industrialized country at the time, who felt the most the need for the fresh mountain air. At first, hiking was mostly recreational and informative, but later developed an athletic side.

Hiking is defined as pedestrian tourism, walk up a mountain, walking through valleys and peaks, on marked or unmarked trails, usually for about one day [4].

If it takes longer than a day, and the trail is more difficult, sometimes going off-

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track, it is called *"trekking"*. Many times, both terms can be used to describe walking up a mountain [5].

It was observed that these activities performed in nature have positive effects on the physical and mental sides of a person, effects confirmed by various studies over time.

Usually, it is thought that people who regularly hike or trek have a better fitness level and, implicitly, better aerobic endurance values, compared to the people who do not practice this type of activities or any kind of sport [5]. Some studies have emphasized the effects of walking in a mountain area on the aerobic endurance.

Hiking actions usually taking longer than 90 minutes, this type of work can be classified as long term, demanding an oxygen uptake of 60-85% of the VO2 max [3] and a heart rate generally between 120 – 150 bpm, with peaks of 180 bpm [7].

The study of the maximal oxygen uptake in different age groups was a preoccupation for various medical or sports researchers.

Maximal oxygen uptake or VO2max is a term that defines a physiological marker, used especially to assess the aerobic endurance. It represents the body's maximal oxygen consumption, being dependent on the heart rate and the respiratory system [2]. This marker has been discussed in detail in other studies and it is not necessary to insist on it here.

It is important to remember, however, a study conducted in the United States that investigated the maximal oxygen uptake in teenagers, between 1999-2000 and 2001-2002, using 2997 subjects aged 12-19 (1478 males and 1519 females), which highlighted the following aspects:

- in males there was a slight increase in the VO2 max values between the ages of 12-15, after which it remained the same [8]. The average VO2 max level for the age of 18 was 46.5 ml/kg/min;
- in females there was a slight decrease in the VO2 max values from the age of 12 to 18 (39 - 37 ml/kg/min). The average level for the age of 18 was 37.4 ml/kg/min. The males had higher values than the females at the same age [8].

The author must mention that for this study he was interested in the values for this marker in older high school students, aged 17-18, and in this sense, he tried to observe the relationship between *hiking* and *maximal oxygen uptake*.

Starting from the premise that for the development of VO2 max one needs work of a certain intensity, repeated with a frequency that is harder to accomplished while hiking, the author believed that an experimental research could highlight better the link (if there is one) between ***hiking***, as a mass and leisure athletic activity among high school students, and an increase of VO2 max values in these young people.

2. Objectives

The main objective of this research was to study the possible effect of regular hiking on the development of maximal oxygen uptake (VO2 max) in high school students.

3. Materials and Methods

3.1. Research hypothesis

It is an accepted fact that the regular practice of hiking/trekking-type activities has beneficial effects on one's health and motor skills. However, for this study the author has formulated the following hypothesis:

Presumably, these activities do not have a significant influence on the development of maximal oxygen uptake in high school students.

3.2. Subjects and methods

The subjects were male high school students, grades 11-12 (17-18 years old), divided in two groups, experimental and control, as follows:

- An experimental group comprising 10 subjects, members of tourism clubs of Bacau, practitioners of hiking-trekking activities.
- A control group comprising also 10 subjects who do not hike regularly, nor do they practice any other sports outside their physical education classes.

The subjects in the experimental group were subjected for one year (October-May) to a regular hiking program, twice a month (1-2 days) during school time, and weekly (usually 2 days) during holidays.

The hiking sessions were between 3 and 5 hours per day, with 10-minute breaks every hour and 2-minute breaks every 15 minutes of continuous uphill hiking. Their heart rate during climbing was between 110-140 bpm, and between 100-130 bpm during dissension.

Both groups were subjected to initial and final tests, applied to assess the maximal oxygen uptake (VO2 max) values. The testing method was chosen taking into account how accessible and how objective the test is.

The VO2 max measurement test consisted in performing a sub-maximal work that would produce an increase in the heart rate of over 125 bpm (125-155 bpm). The work was performed on the cycle ergometer over the course of 6 minutes. At the end of the work, the heart rate was recorded, in the first ten seconds right after, using pulse-testers, in a standing position, the result being calculated per minute.

Then, using the Astrand–Ryhming nomogram, the maximal oxygen uptake (VO2 max) was determined, expressed in liters/minute.

This figure was then divided to the number of kilograms of each subject, in order to get the VO2 max/kg body/minute value.

For the statistical analysis of the data, the author used the analysis of variance (F ratio / ANOVA).

4. Results and Discussions

At the end of the initial and final tests of the two groups, the following results were recorded; they are presented and discussed below:

Initial testing

Initial VO2 max testing Table 1

Specification	Experim. group	Control group
Arithmetical mean (Ml/min/kg)	43.9	40.5
Dispersion	11.4	14.4
Standard deviation	3.37	3.80
Variability coefficient (%)	7.67	9.37
Percentage variation of the control group average in relation to the experimental group (+/- %)	-	-7.74

Nature of variation	Sum of the deviation squares	Degrees of freedom	Corrected dispersions with degrees of freedom	Calculated F	Theoretical F	Significance level
Total variation	315.27	-				
Group variation	57.73	1	57.732	4.04	4.41	5%
Residual variation	257.54	18	14.308			

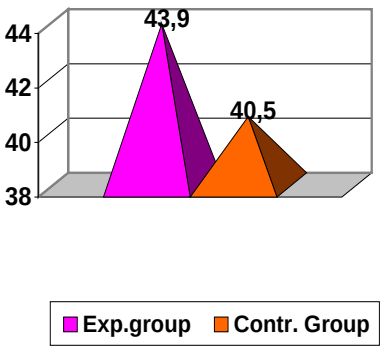

Fig.1. *Initial testing results*

As one can see in the figure, in the case of the initial testing results, the experimental group average is 43.9 ml/min/kg, 7.74% higher than the control group average (40.5 ml/min/kg). Both averages are strictly representative for the two groups.

Nevertheless, the difference between the results recorded by the two groups prove to be insignificant for a 95% probability of guaranteeing the results (F calculated < F theoretical).

Discussions

One can observe, based on the presented results, that there is a slight difference between the experimental and the control group (the control group average recorded a slight deviation compared to the experimental group), however these are insignificant for a 5% significance level. This proves that the groups are comparable from the point of view of the results at this testing. The homogeneity of the two groups, considering the results, is high - the calculated averages are strictly representative for the given series.

Final testing

Final VO2 max testing

Table 2

Specification					Experim. group	Control group
Arithmetical mean (Ml/min/kg)					45.9	41.8
Dispersion					14.7	17.8
Standard deviation					3.83	4.22
Variability coefficient (%)					8.35	10.10
Percentage variation of the control group average in relation to the experimental group (+/- %)					-	-8.94
Nature of variation	Sum of the deviation squares	Degrees of freedom	Corrected dispersions with degrees of freedom	Calculated F	Theoretical F	Significance level
Total variation	409.57	-				
Group variation	84.30	1	84.296	4.67	4.41	5%
Residual variation	325.27	18	18.071			

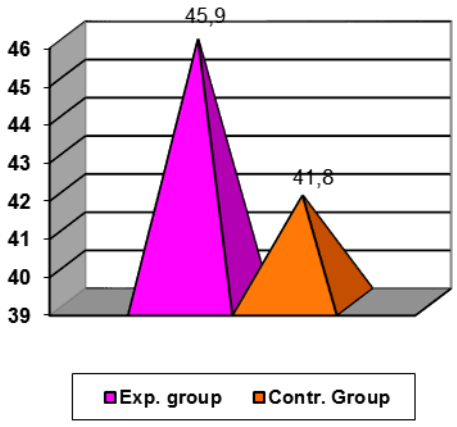

Fig.2. *Final testing results*

Looking at the figure, one can observe that there is a substantial difference in the favour of the experimental group, its average results recorded during the final testing being 8.94% higher than the average results of the control group, both averages being strictly representative for the two groups.

The difference between the results recorded by the two groups prove this time to be significant for a 95% probability of guaranteeing the results (F calculated > F theoretical).

Discussions

During the final testing, after the experimental group was subjected to a hiking program, there was a difference between the results recorded by the experimental group and the control group that are significant for a 5% significance level (according to the one-way ANOVA). Thus, based on the results recorded during the initial testing that showed a lack of significant differences between the groups, the final results highlight the fact that this program has led to a real

increase in the maximal oxygen uptake, considering that both groups were subjected to the same influence variables (other than the experimental ones, primarily the normal biological development for this age).

In this case also, the homogeneity of the two groups is high - the calculated averages are strictly representative for the given series.

5. Conclusions

At the end of the research, one can observe that the maximal oxygen uptake level in both the experimental and the control group recorded a superior level during the final testing, compared to the initial testing, which shows that other factors besides the experimental program have contributed also to its development.

However, the experimental group has recorded final VO2 max values that were significantly superior to the ones recorded by the control group.

The increase in the maximal oxygen uptake was higher in the experimental group, which shows that the experimental factor had significant effects on the performances, with a minimum of 95% probability of guaranteeing the results.

The F ratio shows the existence of a significant difference between the groups; thus, the initial hypothesis is invalidated.

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