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Comparison of power changes in rebound and fast run versus time for 11 year-old boys being in and out of training

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The purpose of this study was to compare the changes in power and speed of running versus time for 11 year-old boys training (n = 17) endurance competitions and being out of training (n = 17). The estimate bases were the changing speed of power on an inclined plane and the change of speed for 400 m run in 25 m sections. In both tests each effort required maximal intensity. During the experimental period very similar characters of speed and power changes versus time were obtained for both tested groups and the differences are due to the training degree.

Key words: endurance, speed, power, inclined plane, boys

1. Introduction

Full biological potential depends, among others, upon the level of fundamental physical features, changing in the process of human development: power, speed, and endurance. It changes along with the age in parallel to the development and growing up process mainly of those systems, which are most responsible for oxygen economy.

The endurance is a feature most openly discussed. This term means the ability to continue long-lasting work of required intensity without any decrease in the activity efficiency and with increased fatigue resistance. Most often it is estimated based on long-lasting run (Cooper's test).

In physiology, the endurance is estimated on the basis of general efficiency of an organism and energetic cost of the performed activity being its measure [4]. In biomechanic testings, the endurance estimate may be found based on the change of maximum power (P_{max}) versus time (t) [2].

The purpose of the testing was to compare the changes in power and speed of run versus time for 11 year-old boys being in and out of training. The following test hypothesis was given: The speed in power changes of rebound and speed of the run versus time are independent of the form of movement, and the differences are due to the training degree.

2. Material and methods

Seventeen untrained boys volunteered to be the subjects to the study. The second group was composed of 17 boys from a sport school, accustomed to physical activity, who had training endurance competition (swimming 5 times a week and running 2 times a week).

Table 1. Physical characteristics of the subjects, Ut = 17, T = 17

Group	Age (months)		Mass (kg)		Height (cm)	
	[med. ± SD]	Range	[med. ± SD]	Range	[med. ± SD]	Range
Ut	131±4.0	125–135	42.3±10.3	30.0–64.0	150.1±6.5	140–163
T	132±4.9	124–140	36.9±8.3	25.5–53.0	144.7±7.3	132–158

2.1. Method of estimating change in running speed in time $V(t)$

In order to determine the maximum running speed V_{max}, the time measurement of 50 m run was performed. After a rest the subject being tested run 400 m starting with maximum speed. The in-between-time measures were done every 25 meters. If the time at the 50 m distance was worse than that obtained earlier, the test was discontinued. The subjects performed tests individually on a tartan runway.

2.2. Methods of power measurements $P(t)$

The estimation of maximum power and its change versus time was done on an inclined plane which assures movement stability and test recurrence. To estimate individual maximum power value (P_{max}) each subject performed 6 rebounds. Then, after a relaxing pause, they performed a series of 40 rebounds, which were the basis for obtaining the data of power value change versus time $P(t)$.

3. Results

Average running speeds at the distance of 400 m were 3.86±0.56 m/s and 4.83±0.36 m/s for the boys being out of and in training, respectively. The difference amounted to 0.97 m/s.

The changes in running speed versus time $V(t)$ are presented in Fig. 1. The curves representing $V(t)$ are divided into proper time intervals, for which straight regression equations were adjusted.

The first time interval was neglected in this case due to increasing running speed. The boys run with a maximum speed during the second time interval, 25 meter long section, and thereafter a rapid speed decrease was noted.

Therefore in the change of running speed two time intervals were considered: from the first speed break and then its relative stabilization (60 s).

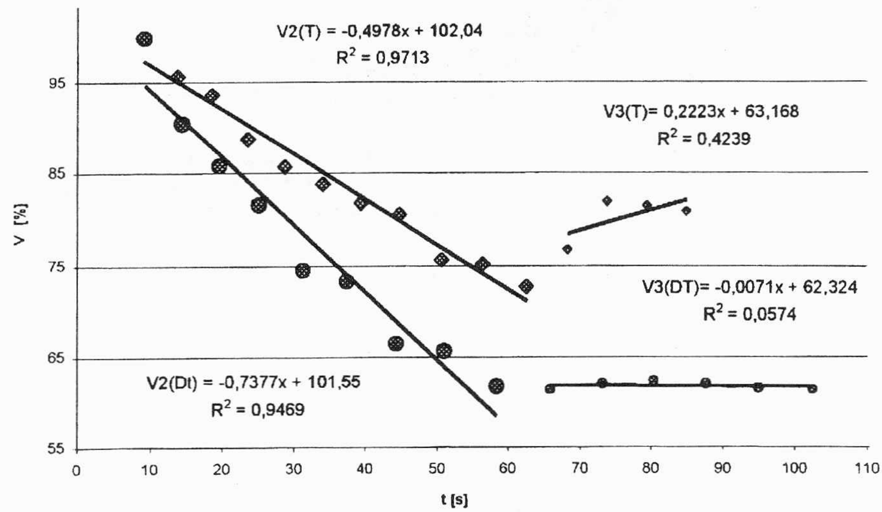

Fig. 1. The change of speed run versus time $V(t)$ for both tested groups

The distance of 400 m is characteristic of the short-time endurance [2].

As to the first time interval of the run, positive values of the co-factor b were obtained, because the boys performed the run from a low start. Thus they covered the first 25 meters with an average speed remarkably lower than the second 25-meter long section, which therefore was not analysed. Only in the second time interval (11–60 s) definite difference in a decrease of running speed is noted.

The third time interval definitely differentiated both tested groups. Untrained boys kept steady running speed ($b = -0.0071$), while the training subjects were able to increase the speed ($b = 0.2223$).

The power changes versus time $P(t)$ during 40 rebounds on an inclined plane (Fig. 2) are similar.

In the first time interval, higher decrease of power was observed in the group of training boys.

In the second time interval (12.5–60 s), definite difference of the tested parameter was noted. Slower decrease of $P(t)$ occurred in the group of training boys, where $b = -0.2895$, while in a group of untrained boys $b = -0.5848$. In the last time interval (over 60 s), the differences are not so significant, although lower decrease of $P(t)$ occurred in a training group.

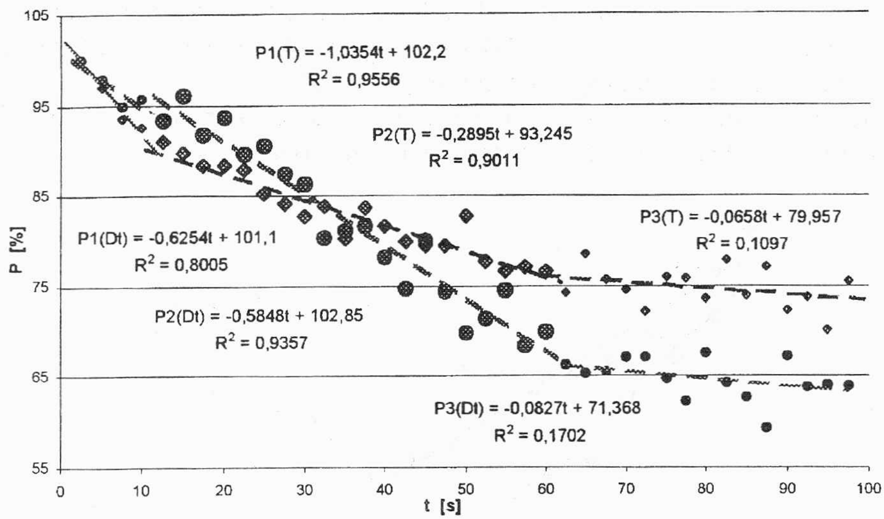

Fig. 2. Power changes versus time $P(t)$ during 40 rebounds on an inclined plane for both tested groups

The comparison of the coefficients b reflecting the change dynamics $V(t)$ and $P(t)$ in proper time intervals is shown in Table 2.

Table 2. Coefficients b of straight regressions in isolated time intervals during running and rebounds on an inclined plane for both groups

Group range	$V(t)$		$P(t)$		
	11–60 s	>60 s	0–10 s	12,5–60 s	>60 s
T	–0.4978	0.2223	–1.0354	–0,2895	–0,0658
Dt	–0.7377	–0.0071	–0.6254	–0,5848	–0,0827

Slower power decrease obtained in a series of 40 rebounds on an inclined plane as well as lower running speed were noted in a group of training boys. Lower values of the coefficient b of straight regression are the proof.

4. Discussion

In sport practice endurance is usually estimated on the basis of long physical effort, where the oxygen exchange is the main source of energy. In such tests the tested subjects do not develop their maximum power, thus their muscles are limited to various energetic compounds. The exercise, which forces the use of maximum energy during the whole experiment, proves to be the most objective measure of energy. According to Howald [3], the maximum exercise intensity can be developed up to about 20 s, then rapid energetic power decrease (exercise intensity) is observed and its relative stabilisation in the interval of 120–180 s, which is connected with higher oxygen exchange.

Similarly, Wolkow [5] connects energetic changes in time with endurance standard. According to him in the efforts lasting up to 10 s, non-milk acid, non-oxygen energy sources are responsible for resynthesis of ATP in 58%.

To about 50 s of effort the participation of these sources in the resynthesis of ATP rapidly decreases for the benefit of glycolytic processes, and then oxygen processes become the main energy supply.

In the movement exercise (running and rebounds on an inclined plane) lasting up to 10 s constant speed and low (average 5.86%) power decrease were observed. In the 11–60 s time interval the difference in the speed of decrease of measured parameters (speed and power) occurred between the tested groups. Higher speed decrease against maximum occurred in group Dt amounting to 38.34%, while in group T it equals only 27.4%.

During a series of rebounds on an inclined plane the groups being in and out of training noted 25.53% and 30.38% power decrease, respectively. Thus data showing speed or power decrease with time is very comparative.

The fact that some untrained boys obtained slightly worse results is well established. In tests with 11 year-old boys who trained swimming, we observed better morphological parameters important from the viewpoint of general physical efficiency compared to the untrained group of the same age. Running and swimming affect most naturally the uniform development of physical features, this development being an exponent of boys' future sport achievements.

The speed increase at the end of running, by the training subjects, is significant. Probably they could accumulate the energy necessary for the finish. Probably it was subconscious action resulting from annual training, not a result of speculative approach to the test. We may suppose that those children in spite of only one year of training possess some endurance and speed reserves provoked by some factors of volitional and motivational nature.

According to Bompa [1] speed reserves had special effect on high level of endurance. A competitor with such a predisposition uses less energy to keep constant (accepted) speed, therefore he is able to increase speed in the final phase of movement act, for instance, running.

The characteristic of the changes in the tested parameters in both groups is very comparative, and noted differences result from the training degree.

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