

## EVALUATION OF SPEED AND AEROBIC ENDURANCE OF STUDENTS FROM THE ASPECT OF WALKING AND RACING ATHLETIC DISCIPLINES

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### ABSTRACT

*Motor skills are at a large percentage present in athletic disciplines, and their participation is closely linked to the manifestation of technical performance. They are a kind of indicator of the level of adoption of athletic technique and overall performance. Athletic disciplines are a good field for the manifestation of motor skills and represent adequate predictors in the manifestation of motor skills. It is on the basis of this fact that the current research was conducted on a sample of 25 male students of Faculty of Physical Education and Sport, East Sarajevo. Running variables (100m, 200m, 400m, 800m) were measured to assess speed in athletic disciplines, while aerobic endurance was assessed via Sport walking (2km). All results were measured according to IAAF rules. For all disciplines, the achieved time (t) on the given track (S) was determined. Based on these parameters, the average speed (m/s) of each subject for each discipline was determined using the formula  $V=S/t$ . Athletic disciplines have been shown to be a good predictor in the analysis of speed and endurance and their subspaces.*

**Keywords:** Running disciplines, race walking, evaluation, motor skills.

### 1. INTRODUCTION

Athletic sprinting disciplines belong to cyclical locomotor movements of maximum intensity and are characterized by the occurrence of oxygen debt, anaerobic mode of operation, maximum frequency and amplitude of movements, high degree of CNS mobility (Idrizović, 2010; Mihajlović, 2010; Pavlović, 2014). Motor abilities, as components of the motor potential of young people, are mostly expressed in an integral way, which is why, at the youngest age, basic physical preparation is discussed in the first phase of training. According to Smajlović (2010), the stages of specialization of athletic disciplines require the dominance of leading qualities, which implies that each athletic discipline has its own model of motor skills. One of the dominant motor skills in sprinting disciplines is speed, which is manifested through latent motor reaction time, frequency of movement, speed of individual movement (Nićin, 2000; Tončev, 2000), and so-called sprint speed (Stojiljković, 2003). Speed as such is generally highly genetically innate and depends on the degree of CNS development and the mass of white muscle fibers (Smajlović, 2010; Pavlović, 2014). However, speed is also influenced by other factors such as the level of development of the skeletal-muscular system, movement techniques, training, strength, endurance, coordination, etc. This is especially evident in disciplines longer than 100 meters, where the so-called speed endurance comes to light, as well as other ways of providing energy, participation of different muscle fibers, etc. In relation to sprinting, sport walking is a moderate to high intensity cyclical activity that takes place under aerobic conditions. It is characterized by high oxygen consumption, maximum frequency (180-200 rpm) and amplitude of movement (105-130cm) depending on the morphological status of the walker, resulting in an average speed of about 3.8m/s (Stefanović, Bošnjak, 2011). On the technical side, regardless of the high intensity, the movements of the walker are soft and synchronized. It is mainly about the dominance of red muscle fibers, because in intensity and length of activity, walkers are similar to 10,000-meter runners and marathon runners. It is an indisputable fact that sports walking is correlated with endurance, speed, coordination of movement and during walking all the muscles are activated and the cardiovascular system works in optimal mode (Pavlović, 2014).

Both types of athletic disciplines, sprinting and walking, depend on the good synchronization of the morphological, motor and functional space of the individual. However, one should never forget the technique of performing a specific athletic discipline as well as many other endogenous-exogenous factors.

Given that the student population of physical education and sport is a part of the group of physically active people, the main objective of the research was to evaluate the speed and endurance, achieved results and average speeds in terms of racing and walking disciplines.

## 2. METHODS AND MATERIALS

The study included 25 male students on the third year of studies (Body Height=174.84 cm; Body Weight=75.92 kg; BMI=22.90 kg/m<sup>2</sup>), physically healthy without any somatic changes and injuries to the locomotor apparatus that could possibly negatively affected the measurement results. Running variables (100m, 200m, 400m, 800m) were measured to assess speed in athletic disciplines, while aerobic endurance was assessed through race walking (2km). Athletic disciplines were measured in accordance with IAAF rules, 2016/2017 in Athletics 1 subject. The time (t) achieved on the course (S) was determined for all disciplines. Based on these parameters, the average speed (m/s) of each subject for each discipline was determined using the formula  $v=S/t$ . The distribution of average speed in racing and walking disciplines was calculated individually and cumulatively. Using the Statistical 10.0 software package basic central and dispersion parameters were calculated, which enabled correct interpretation of the results.

## 3. RESULTS AND DISCUSSION

Table 1 shows the results of the student's running and walking disciplines. Generally, the results represent a common profile of the students' morphological, motor and functional space assessed through speed of running and walking. From the aspect of homogeneity of results, this is a heterogeneous sample of students, which is manifested by higher CV% values, especially in the disciplines 200m (CV%=11.08), 400m (CV%=10.31) and 800m (CV%=10.92), compared to running 100m and race walking 2km (Table 1).

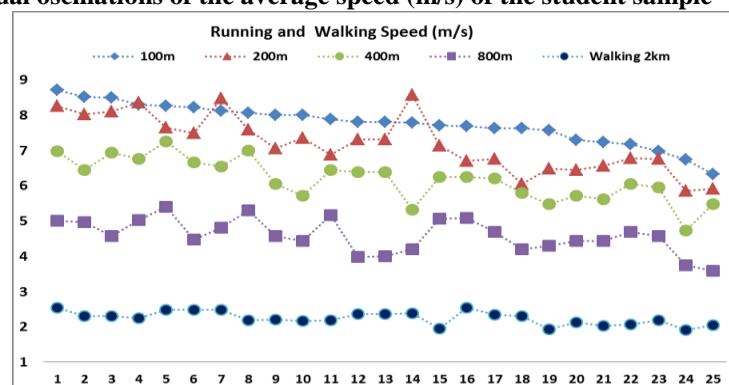
**Table 1: Descriptive statistics the parameters**

The time achieved and average speed	Mean $\pm$ SD	Min	Max	CV%
<b>100m (t)</b>	12.93 $\pm$ 1.00	11.48	15.76	7.72
<b>V (m/s)</b>	7.76 $\pm$ 0.57	6.34	8.71	7.28
<b>200m (t)</b>	28.05 $\pm$ 3.11	23.30	34.16	11.08
<b>V (m/s)</b>	7.20 $\pm$ 0.80	5.86	8.58	11.05
<b>400m (t)</b>	65.33 $\pm$ 6.73	55.10	84.22	10.31
<b>V (m/s)</b>	6.18 $\pm$ 0.61	4.74	7.26	9.80
<b>800m (t)</b>	176.16 $\pm$ 19.24	148.00	223.00	10.92
<b>V (m/s)</b>	4.59 $\pm$ 0.48	3.59	5.40	10.37
<b>Walking 2km (t)</b>	14.88 $\pm$ 1.28	13.05	17.33	8.60
<b>V (m/s)</b>	2.25 $\pm$ 0.19	1.92	2.55	8.39

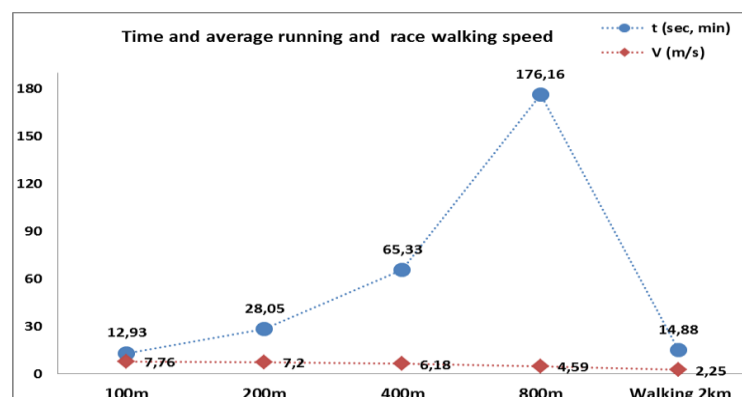
**Abbreviations:** Mean-average value; SD- standard deviation; Min-minimal results; Max-maximal results; CV%-coefficient of variation; V (m/s)-average speed

Average achieved time in 100 m is 12.93 sec. at an average speed (V=7.76 m/s). With increasing distance to 200m the average result increases (t=28.05 sec) as well as the average speed on the track (V=7.20 m/s). Students ran the 400 m section in 65.33 s. with an average speed (V=6.18 m/s) while the 800 m stock ran an average of 176.16 sec (2:56.16) and average speed (V=4.59 m/s). This is a logical sequence of results, since these are different running distances and hence the difference in running time and running result (Fig. 1).

**Figure 1: Individual oscillations of the average speed (m/s) of the student sample**



**Figure 2: The ratio of score (time) and average speed (m/s) in athletic disciplines**



What can be concluded is that there are evident oscillations in terms of average running speed (m/s), which is inversely related to the length of the section and ranges from ( $V=7.76$  m/s) by 100 m to ( $V=4.59$  m/s) by 800 m (Fig.2). Here, a decrease in the average running speed resulting from fatigue due to the formation of lactic acid in the body (lactate) is evident. Numerically, this amounts from  $V=0.56$  m/sec (100 m-200 m),  $V=1.02$  m/sec (200 m-400 m) to  $V=1.59$  m/s (400 m-800 m). Identical conclusions can be drawn for the 2 km walking discipline. The average walking distance of 2 km students is 14.88 min with an achieved walking speed of 2.25 m/s, where the difference between the minimum and maximum average speed is about 0.63 m/s. The lower result of sports walking is fatigue on a larger scale due to the accumulation of larger amounts of lactic acid in the blood. Compared to running at 400 m and 800 m, in the discipline of walking at 2 km it was not so fast to reach the so-called deadlock phenomena, as in the 400 m and 800 m, when the race starts at maximum intensity, causing acid products to accumulate faster. The smallest individual oscillations of students are observed at 100 m, where a constant decrease of the average speed is recorded, as opposed to 200 m, 400 m, 800 m which reflect the considerable heterogeneity of the average speed of students. However, in several individual cases of students a higher average speed has been achieved on the longer than the shorter track. This can be explained by the different anaerobic-aerobic capacity of the subjects, the different muscle structure, the representation of white and red muscle fibres, the state of training, the motivation of the subjects at the moment of measurement, etc. Compared to racing disciplines, the subjects were more homogeneous at an average walking speed of 2 km. It can be concluded that their aerobic potentials are almost identical, which again depends on the above mentioned factors (oxygen consumption, muscle morphology, training, motivation, walking technique, etc.).

#### 4. DISCUSSION

The current research has been carried out with the aim of evaluating the speed, average speed, endurance of students in terms of walking and racing athletic disciplines. The obtained results are consistent to some previous research for the student population (Pavlovi, 2005, 2008; Pavlović, & Raković, 2009; Idrizović, Pavlović, & Banjević, 2013; Pavlović, Raković, & Stanković (2014) which is at the stage of completion of the formation of definitive morphological status and still developing some motor abilities. Speed as a motor ability is known to be highly genetically innate (Milanović, & Šnajder, 1991; Nićin, 2000; Stojiljković, 2003), and depends on good function of CNS (Zaciorski, 1975). In sprint disciplines all its manifestations (latent motor response time, frequency of movement, speed of single movement, sprint speed) are manifested, which with good synchronization are a precondition for good result. From the kinetic aspect it is known that the force impulse produced by the sprinter at the start is proportional to the length of the action of the sprinter on the starting blocks and the exerted force, therefore, it is necessary to develop the speed possibilities of muscles which stretch the leg and back. Also, the quantitative criteria of kinematic and dynamic oscillations of a racing step in runners can be quite different, and they differ in morphological structure, level of motor development, adopted technique, etc. For top sprinters, differences generally occur between the length and frequency of the steps, which are inversely related. Each sprinter, with respect to their morphological characteristics and motor skills, can develop its maximum speed by developing an optimal relationship between stride length and frequency, which is why they need perfect movement coordination, which is first manifested in active contact with the ground. According to Mihajlović (2010), in order to develop an optimal ratio of stride length and frequency, it is necessary that the duration of the supporting phase and the exertion of muscle force correspond to the running speed, since deviation from the optimal development of muscle force in a certain time interval certainly spoils the result, i.e. running speed.

The problem of length and frequency of steps is also a technical problem, a problem of development of psychophysical qualities of a runner, body structure, quality of the substrate, etc. However, both components are equally important for running speed and track record, regardless of track length. Runners also have obvious differences between the time of the support and flight periods, the size of the substrate reaction, etc. Better runners have a slightly shorter depreciation path in the front support phase, and also need a shorter time to arrange a proper reflection than the support in the rear support phase. Depending on the quality of the sprinter, the oscillations of the centre of gravity of the body, which should be as small as possible, or even, where the take-off angle decreases with increasing speed of running, depend (Pavlović, 2014). If the supporting phase is shortened when running, it will not be possible to develop the required muscle force in a short time, which disrupts the rhythm of running. Otherwise, if excessive muscle force is exerted, it consumes energy reserves in the muscles and the movements become convulsive.

By analysing sample, we can see some disadvantages, which are manifested by poor running technique, quality of the substrate, underdeveloped some form of speed, body structure, insufficient synchronization of the cardiovascular and respiratory system with the locomotive apparatus, the state of the muscular system, etc. Unlike speed, durability is still subject to modification depending on the model being applied. In this regard, the results of the realized research reflect heterogeneity in the parameters of speed in relation to the discipline of walking, which is in the domain of aerobic endurance. What is evident is the ratio of athletic racing discipline scores, depending on the given running distance. The results of student running are inversely related to the length of the section, as expected. It is evident that as the length of the section increases, the speed of running decreases, the body fatigue occurs as a result of the accumulation of larger amounts of lactic acid in the blood, which affects the fatigue to a greater extent. This is especially evident in the average velocity that records the downward trend (Fig.2). Compared to the results of racing disciplines, sport walking as a form of aerobic activity has considerable homogeneity with quite uniform parameters of speed and average speed of the students. Compared to running (400 m, 800 m) in sports walking at 2 km, we have not so easily come up to the so-called "deadlock" phenomenon, when the race starts at maximum intensity, which leads to faster accumulation of acidic products. Walking is an activity of moderate to high intensity, depending on aerobic capacity, which allows for optimal mode of operation under aerobic oxygen consumption. Therefore, regardless of the technical adoption of the movement, it is impossible to accumulate lactic acid in the body, which would stop performing a specific activity, in this case, sports walking. Previous research on the student population (Medved, 1987) has shown that with increasing section length, the percentage of aerobic capacity increases relative to anaerobic, thereby reducing maximum oxygen consumption. At 100m the percentage ratio is (9%AE: 91% AN), where with the length of distance the percentage of aerobic energy (AE) increases and the percentage of anaerobic energy (AN) decreases. For 200m (16AE:84AN), 400m (25 AE:75AN), 800m (41AE:59AN). Also, with increasing distance energy consumption (kJ) increases from 231kJ for 100m to 546kJ for 800m (Nikolić, 1995), while reducing the percentage of anaerobic release of energy (Bajić, & Jakonić, 1996).

The smallest individual oscillations of students are observed at 100m, where a constant decrease of the average speed is recorded, as opposed to 200m, 400m, 800m which reflect a considerable heterogeneity of the average speed. Several individual cases record that a higher average speed was achieved over the long run than at the shorter track (Fig. 1). This can be explained by the different anaerobic-aerobic capacity of the students, different muscle structure, the representation of white and red muscle fibres, the state of training, motivation, etc. Compared to racing disciplines, the subjects were more homogeneous at an average walking speed of 2 km. It can be concluded that their aerobic potentials are almost identical, which again depends on the above mentioned factors (oxygen consumption, muscle morphology, training, motivation, walking technique, etc.).

## 5. CONCLUSION

Generally, the defined sample of respondents reflects homogeneity in the results of sport walking where primary endurance is unlike sprinting disciplines where speed and endurance are dominant. Athletic disciplines have been shown to be a good predictor in the analysis of speed and endurance as motor components and their subspaces. Achievement oscillations (t) are evident in both groups of disciplines. There is also an evident inverse relationship between the average speed of students (m/s) on the course in relation to the length of the course (s), where the trend of decreasing results is recorded. The analysis of the individual results shows that the achieved track time and average speed in these disciplines are not linear trend. We have individual cases where the same candidate had a higher average running speed in the longer runs than in the shorter ones. This speaks in favour of different motor-functional profiles of students, their different energy potential, skeletal-muscular structure, movement technique as well as the degree of motivation.

## 6. REFERENCES

- Bajić, M., & Jakonić, D. (1996). Fiziologija sa osnovama biohemije i higijene sporta [Physiology with the basics of biochemistry and hygiene of sports. In Serbian] Novi Sad: Faculty of Physical Education.
- Idrizović, K. (2010). Atletika I i II. [Athletics I, II. In Serbian] Univerzitet Crne Gore: Biblioteka biomedicinskih nauka.
- Idrizović, K., Pavlović, R., & Banjević, B. (2013). Funkcionalno-motorički osnov atletskog sprinta [Functional-motor base of athletic sprint. In Serbian] 6<sup>th</sup> International interdisciplinary scientific U Zborniku V. Bunčić (ur.), VI Međunarodna interdisciplinarna naučno-stručna konferencija "Vaspitno-obrazovni i sportski horizonti" (290-292). Visoka škola strukovnih studija za obrazovanje vaspitača i trenera. Subotica.
- Milanović, D., & Šnajder, V. (1991). Atletika-hodanja i trčanja. [Athletics-walking and running. In Croatian] Sveučilište u Zagrebu.
- Medved, R. (1987). Sportska medicina [Sports medicine. In Serbian] Medicinska naklada. Zagreb
- Mihajlović, I. (2010). Atletika. [Athletics. In Serbian] Novi Sad: Fakultet sporta i fizičkog vaspitanja
- Nikolić, Z. (1995). Fiziologija fizičke aktivnosti [Physiology of physical activity. In Serbian] Beograd: Fakultet fizičke kulture.
- Pavlović, R. (2005). Povezanost varijabli brzine i koordinacije sa rezultatom trčanja 400m [Relationship between speed and coordination variables with 400m running results. In Serbian] U zborniku D. Živković (Ur.), XI. Međunarodni naučni skup "Fis komunikacije u fizičkom vaspitanju, sportu i rekreaciji" (38-43). Niš: Fakultet fizičke kulture
- Pavlović, R. (2008). Relacije varijabli brzine sa rezultatom trčanja 100m [Relation of speed variables with running result 100m. In Serbian]. *SPORT MONT*, 6 (15-17), 522-527.
- Pavlović, R. & Raković, A. (2009). Antropološke dimenzije kao prediktori aerobne izdržljivosti [Anthropological dimensions as predictors of aerobic endurance. In Serbian]. *SPORT MONT*, 6 (18-20), 20-325.
- Pavlović, R., Raković, A., & Stanković, D. (2014). Razlike između BiH atletičara-juniora i studenata fizičkog vaspitanja i sporta u trkačkim disciplinama [Differences between BiH junior athletes and physical education and sports students in racing disciplines. In Serbian]. U Zborniku V. Šeparović (Ur.) VII Međunarodni simpozijum Sport i zdravlje (39-44) Tuzla: Fakultet tjelesnog odgoja i sporta.
- Pavlović, R. (2014). Atletika [Athletics. In Serbian] SIA. Niš.
- Stojiljković, S. (2003). Osnove opšte antropomotorike [Basics of Anthropomotoric. In Serbian] Studentski kulturni centar. Niš
- Smajlović, N. (2010). Atletika [Athletics. In Serbian] Sarajevo: Fakultet sporta i tjelesnog odgoja.
- Stefanović, Đ., & Bošnjak, G. (2011). Atletika-filosofsko-naučne osnove i primena u praksi [Athletics-philosophical-scientific foundations and application in practice. In Serbian] Banja Luka: Fakultet fizičkog vaspitanja i sporta.
- Tončev, I. (2001). Atletika tehnika i obučavanje [Athletics- techniques and metodics. In Serbian] Novi Sad: Fakultet fizičke kulture.
- Zaciorskij, V. M. (1975). Fizička svojstva sportista [Physical properties of athletes. In Serbian]. Beograd: NIP-Partizan.