ORIGINAL ARTICLE

The influence of motor skills on the short sprint results

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Abstract

Background and Study Aim The curriculum of physical education in high schools is based on learning motor skills, as well as their development in sports sections, where the 100-meter sprint dominates. The aim of the study was to determine the influence of motor skills on the 100 m running results.

Material and Methods The research was conducted on a sample of 80 high school students in Novi Pazar and Kraljevo, aged 16 and 17 years (± 6 months). 12 variables were used to assess motor skills, three variables each: explosive power, segmental speed, repetitive power, and flexibility (standing long jump), triple jump, five jumps. For estimating segmental speed: foot tapping, hand tapping, foot tapping on the wall. For the assessment of repetitive power: lifting the torso on the Swedish bench, mixed pull-ups, squats. To assess flexibility: deep bench press, twine, stick twist.

Results Results were obtained to confirm that there is a positive influence of motor skills on the 100 m sprint results at the level of (p=.000). The results in the 100 m sprints are statistically significantly dependent on the motor skills that manifest segmental speed and explosive power. Variables (standing long jump, foot tapping on the wall and foot tapping) have a statistically significant effect on the criterion variable of the 100 m sprint.

Conclusions: Recommendation to future researchers would be to conduct a study over a longer period of time with the aim of examining the biomechanical factors that determine the success in sprint, is the production of force in the phase of sprint acceleration and sprint deceleration.

Keywords: students, teaching, athletics, explosive strength, speed

Introduction

Physical education classes in secondary schools are based on learning motor skills [1, 2]. As physical education is inadequately represented by the weekly number of hours (two hours), teaching is realized with a low energy component, which is a big problem in achieving the goal and tasks of teaching physical education. Due to such insufficient efficiency of physical education classes, a larger number of children are included in additional exercises within the school section for physical education or in training work in sports organizations. In order to improve the teaching process in secondary schools, research that determines the impact of anthropological status on the specific motor abilities of secondary school students is of scientific interest. Motor skills as the most important factor of anthropological status in the teaching of physical education are mainly related to the influence and relations with other segments: motor, morphological, functional, etc. The importance of anthropology and morphology in attaining better motor fitness including sprint and the use of motor tests to enhance performance is well documented [3, 4]. One of such segments is the short sprint, which is the subject of research in this article.

Numerous studies showed to a positive relationship between motor skills, and short sprint results [6, 9]. Recent research also indicates that short sprints are a success factor in a number of sports [10, 14]. The most important factors for achieving high results of short sprints are good technique, speed of alternative movements, explosive power as well as maximum force of tried movements [5]. Given the high rate of innate speed (90-95%) training can have very little effect on its development [15, 16]. Studies have also established a predictive association between motor skills and sprints in statistical terms [17]. However, this does not mean that the development of speed should not be influenced, especially in terms of its complex manifestation, but it should be realistic in expectations. Therefore, speed training is mainly focused on the development of reaction speed, the speed of performing one movement and the speed of alternative (frequency) movements. For the development of specific speed, the intensity of technical-tactical exercises is maximum. The pause between repetitions in one series is 1-3s (for

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reaction speed and speed of one movement) or none at all (for movement frequency). The number of repetitions in one series depends on the task being performed and the preparedness of an athlete, usually (10-15), while the amount of series per task is (3-5). The pauses between series should be long enough to ensure that the performance speed will be at the level of the previous one [5]. It should be noted that the application of different training methods (for example, plyometric training, resistance training) in a long period of time has a positive effect on the development of short sprints [18, 19].

At the beginning of a sprint run, the ability to generate high concentric force and generate high speed during acceleration is of primary importance for success in short sprints. Shen [20] showed that a 100 m sprint can be divided into 3 different phases: acceleration, maximum speed and deceleration. The acceleration phase can be divided into several sub-phases: initial or initial acceleration (0-12 m), which is mainly characterized by a constant increase in stride length and main acceleration (12-35 m). When the acceleration phase is of sufficient length and the optimal value of the driving speed, the sprinter is not able to maintain the maximum speed and a long deceleration phase occurs [20]. Professional sprinters reach a maximum speed between (50-70 m), and are capable of crossing another (20 m), or rarely (30 m) [21]. Thus, the third transition sub-phase (35-60 m) takes place only at the elite level and lasts until the sprinter reaches the level of maximum running speed. At this stage, the sprinter reaches the maximum stride length, stride frequency and maximum speed. The deceleration was marked only by the last (10 m) of the 100 m sprint [22]. *The aim of the study* was to determine the influence of motor skills on the 100 m running results.

Material and Methods

Participants

The research was conducted on a sample of 80 high school students in Novi Pazar and Kraljevo, aged 16 and 17 (± 6 months). All participants conducted their activity in regular physical education classes and with three hours a week training process as selected athletes as part of additional classes. The subjects included in the research were healthy and without any chronic diseases, heart problems, is without injuries of the locomotor system that would affect the test results.

Research Design

A total of 12 tests were used to assess motor skills, three tests each: explosive power, segmental speed, repetition power and flexibility [23]. For the assessment of explosive power: standing long jump (MSDM), triple jump (MTRS), five jumps (MPTS). For estimating segmental speed: foot tapping (MTAN), hand tapping (MTAR), foot tapping on the wall (MTAZ). For the assessment of repetitive power: lifting the torso on the Swedish bench (MDTK), mixed pull-ups (MMZG), squats (MČUČ). To assess flexibility: deep bench press (MDPK), twine (MŠPA), stick twist (MISP). A 100 m sprint was used to evaluate the results of running speed [24].

Statistical Analysis

The data obtained by the previously described procedure were processed by the SPSS 17 statistical program (Statistical Package for Social Science, v17.0, SPSS Inc., Chicago, IL, USA). Basic descriptive parameters were used for data processing: arithmetic mean (Mean), minimum value (Min), maximum value (Max), standard deviation (SD), asymmetry measures (Skewness and Kurtosis).

Regression analysis in this study was used to determine the influence of motor skills (predictor system), on the 100 m sprint results (criterion system). Relevant parameters were calculated for regression analysis: correlation coefficient (R); partial correlation coefficient (Part-R); standardized partial regression coefficient (Beta); multiple correlation coefficient (R); coefficient of determination (R^2); value F - ratio (F); level of significance (p); The significance level was set at $p<0.05$.

Results

The results found in the Table 1 in the subjects in the area of motor abilities of the subjects show that in none of the tests there are significant deviations of the results from the normal distribution. There are at least five standard deviations (SD) in the intervals of minimum (Min) and maximum (Max) results, which indicates a significant dispersion, i.e., sensitivity of motor tests. The values of Skewness show that there are no significant deviations of the results from the normal distribution in any of the measures, considering that the values do not exceed 1.00 in any of the tests. The Kurtosis values in all tests are below 2.75, which indicates platykurtic distribution.

The obtained results of motor skills do not deviate from the results of similar researches verified in our country on this population of examinees, and thus the application of multivariate methods of processing the results in this research is enabled.

The results determined in the Table 2 in the subjects in the area of sprint running of the subjects show that there are no significant deviations of the results from the normal distribution. The values of Skewness show that there are no significant deviations of the results from the normal distribution, considering that the value does not exceed 1.00. The Kurtosis values in all tests are below 2.75, which indicates platykurtic distribution. The obtained results of sprint running do not deviate from the results of similar researches verified in our country on this population of examinees, and thus the application of multivariate methods of processing the results in this research is enabled. Generalization of the results on the population from which the sample of these participants was derived is thus possible.

Based on the value of the multiple correlation coefficient (R=.81) in the Table 3, it can be stated that motor skills (as a predictor system), based on the size of the coefficient F ratio (5.18) and its significance (p=.000), explain statistically significantly achieved in the short sprint results (TR 100). The coefficient of determination of the criterion variable (R^2) and the system of motor

Table 1. Basic statistical parameters for the assessment of motor skills

Variables	N	Mean	Min	Max	SD	Skewness	Kurtosis
MSDM	80	183.21	150.00	255.00	9.17	-0.058	1.310
MTRS	80	446.07	390.00	571.00	9.28	-.599	-0.667
MPTS	80	648.63	562.00	715.00	0.28	0.049	-1.065
MTAN	80	28.49	22.00	39.00	4.16	0.385	0.739
MTAR	80	36.55	29.00	46.00	11.47	-0.526	-0.397
MTAZ	80	24.94	19.00	32.00	15.44	-0.635	0.811
MDTK	80	11.62	8.00	27.00	6.49	-0.142	-0.710
MMZG	80	13.69	9.00	25.00	32.60	0.213	1.765
MČUČ	80	19.79	12.00	38.00	3.43	-.231	1.275
MDPK	80	26.33	17.00	44.00	4.14	0.66	0.175
MŠPA	80	156.06	130.00	191.00	3.84	0.193	0.899
MISP	80	76.49	57.00	100.00	2.02	0.939	2.733

Note: number of participants (N), arithmetic mean (Mean), minimum (Min), maximum (Max), standard deviation (SD), standing long jump (MSDM), triple jump (MTRS), five jump (MPTS), foot tapping (MTAN), hand tapping (MTAR), foot tapping on the wall (MTAZ), lifting the torso on the Swedish bench (MDTK), mixed pull-ups (MMZG), squats (MČUČ), deep bench press (MDPK), twine (MŠPA), stick twist (MISP).

Table 2. Basic statistical parameters for the assessment of 100 sprints

Variables	N	Mean	Min	Max	SD	Skewness	Kurtosis
TR100	80	12.58	12.46	14.35	11.48	0.314	1.019

Note: number of participants (N), arithmetic mean (Mean), minimum (Min), maximum (Max), standard

deviation (SD), 100m sprint (TR100).

Table 3. Regression analysis of motor abilities and criteria variables sprint 100 m

R	R^2	F	p
.81	.64	5.18	.000

Note: multiple correlation coefficient (R), coefficient of determination (R^2), size of F - relationship (F), level of significance (p)

tests have 64% of common relations. The other 36% of the common variability explain the criterion variables contained in other dimensions of the anthropological space that were not the subject of research in this article.

The results of partial regression (Beta) and its significance (p), at the univariate level, indicate that statistically significant influence on the criterion variable (TR 100), have the following motor variables: standing long jump (MSDM .002), foot tapping on the wall (MTAZ .003) foot tapping (MTAN .005). The following variables also have an influence: hand tapping (MTAR .008), mixed pull-ups (MMZG .008) and squats (MČUČ .009), however, this significance is not at a statistically significant level of ($p<0.05$). The obtained results of partial regression (Beta) and its significance (p), indicate that the subjects will achieve better results in the 100 m sprints (TR 100), if they have better motor skills.

Discussion

The primary aim of the study was to determine the influence of motor skills on the 100 m running results. Results were obtained that show that there is a statistically significant influence of motor skills (predictor variables) on the 100 m sprint results (criterion variables) at the level of ($p=.000$). Variable for estimating explosive power: standing long jump (MSDM) and segmental speed variables: foot tapping on the wall (MTAZ) and foot tapping (MTAN) have a statistically significant effect on the 100 m running results (TR 100). The variables also have a significant influence: hand tapping (MTAR), mixed

Table 4. Statistical significance parameters for the assessment of 100 sprints

Variables	R	Part-R	Beta	p
MSDM	-0.36	-0.12	-4.15	**.002**
MTRS	-0.16	-0.16	-1.42	.188
MPTS	0.16	0.16	1.50	.210
MTAN	-0.38	-0.35	-3.90	**.005**
MTAR	-0.31	-0.24	-3.71	.008
MTAZ	-0.28	-0.18	-3.63	**.003**
MDTK	0.17	0.18	1.44	.155
MMZG	-0.59	-0.50	-3.75	.008
MČUČ	0.51	0.50	3.80	.009
MDPK	-0.11	-0.11	-0.05	.268
MŠPA	-0.15	-0.15	-1.40	.198
MISP	-0.12	-0.12	-1.16	.170

Note: correlation coefficient (R), partial correlation coefficient (Part-R), standardized partial regression coefficient (Beta), level of significance (p); standing long jump (MSDM), triple jump (MTRS), five jump (MPTS), foot tapping (MTAN), hand tapping (MTAR), foot tapping on the wall (MTAZ), lifting the torso on the Swedish bench (MDTK), mixed pull-ups (MMZG), squats (MČUČ), deep bench press (MDPK), twine (MŠPA), stick twist (MISP).

pull-ups (MMZG) and squats (MČUČ), however, this significance is not at a statistically significant ($p<0.05$). Therefore, the obtained results indicate that the success in 100 m short sprints mostly depends on the explosive power and segmental speed.

The results obtained in this way can be said to be expected, because the most important factors for achieving high results of short sprints are the speed of alternative movements, explosive power as well as maximum strength, acquired in squats and strength exercises, is significantly associated with the effect of sprints. The end result of running short sprints depends on the speed of reaction at the start, the ability to show speed in the shortest possible time, as well as on maintaining the maximum speed reached to the finish line [25]. The obtained results can be explained by the fact that in the stage of running at maximum speed on short sprints, the most important structural element of movement is active reflection with the reflecting leg and fast pulling upwards of the swinging leg, previously maximally bent at the knee joint in the phase of the last swing. At the end of the flight phase, the runner performs a downward action with the swinging leg, stretching the leg at the knee and touching the ground with the front part of the foot, and with the reflecting leg, which bends at the same time, it approaches the swinging leg [5]. Also, the high level of explosive power of the lower extremities is positively related to acceleration [26]. Aksović [18] showed that motor skills: speed, power, as well as maximum force of tried movements have a great influence on the results of short sprints in relation to motor abilities: precision, balance, coordination and flexibility, which have less influence in relation to the above motor skills [18]. Maćkala et al. [27] showed a strong correlation between explosive power and short sprints, indicating that step frequency is the most important factor in the development of maximum speed during the initial and secondary phases of acceleration [27]. Biomechanical factors such as: reaction time, techniques, electromyography (EMG), force production, neuronal factors and muscle structure have a significant role in the short sprint. At the beginning of a sprint run, it is important to produce a lot of force and generate a lot of speed in the acceleration phases. During the constant speed phase, activities immediately before and during the stopping phase are important to increase the explosive force/power and efficiency of movement in the propulsion phase. However, there are no studies that have examined the production of force in the phase of sprint acceleration and sprint deceleration, which is a recommendation for future researchers [28].

Conclusions

The research was conducted with the aim of determining the influence of motor skills on the 100 m running results. Using regression analysis, the results were obtained to confirm that there is a positive influence of motor skills on the 100 m sprint results at the level of significance ($p=.000$). Variable for estimating explosive power: standing long jump and segmental speed variables: foot tapping on the wall and foot tapping have a statistically significant effect on the criterion variable of 100 m running results. It can be concluded that the results in the 100 m sprints are statistically significantly dependent on the motor skills that manifest segmental speed and explosive power. Recommendation to future researchers would be to conduct a study over a longer period of time with the aim of examining the biomechanical factors that determine the success in sprints, i.e., the production of force in the phase of sprint acceleration and sprint deceleration. The theoretical and practical value of this research is that high school physical education teachers will increase the level of information on the influence of motor skills on the 100 m running results, which will lead to better results in the realization of program tasks of developing abilities and traits and motor skills of students.

Highlights

– positive influence of motor skills on the 100 m sprint results at the level of significance;
– standing long jump, foot tapping on the wall and foot tapping have a statistically significant effect on the criterion variable of 100 m running results;
– the results in the 100 m sprints are statistically significantly dependent on the motor skills that manifest segmental speed and explosive power.

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Conflicts of interest
All authors have no conflicts of interest.

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