

Transferable skills from strength to speed of running

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Abstract:

One cannot be an elite athlete today without developing superior levels of maximal strength. This is accomplished by increasing physical strength, which is the result of the strength components responsible for muscle movement and movement speed. The study focused on the results collected from a group of 80 individuals divided into three groups that utilized different strength training methods under the supervision of a monitoring group. The results showed that increasing the maximal strength indicators by 15.03 percent increased the running speed for the 0-30 m run by 6.9 percent m/sec and 0.31 sec, the 30-60 m run by 4.05 percent m/sec and 0.15 sec, and the 60 m run by 6.02 percent m/sec and 0.45 sec. The increase in force indicators of 13.72 percent achieved through maximal power exercises resulted in an improvement in running speed of 6.25 percent m/sec and 0.25 sec for 0-30 m, 5.54 percent m/sec and 0.21 sec for 30-60 m, and 6.57 percent m/sec and 0.54 sec for 60 m. Plyometric exercises improved running speed for 0-30 m by 4.7 percent m/sec and 0.19 sec, 30-60 m by 3.96 percent m/sec and 0.15 sec, and 60 m by 3.53 percent m/sec and 0.31 sec by improving force indicators by 13.72 percent. The results showed that the program for developing maximal strength is more productive for the 0-30 m distance, but the program for developing maximal power appears to be more convenient for the 30-60 m distance. The maximal power program is capable of producing better results at a 60 m distance, but it is closely followed by the maximal strength program. Plyometric exercises had a significant impact as well, but with a lower success rate when compared to maximal strength or maximal power exercises.

Key Words: Strength training, power exercises, plyometric exercises, the impact of strength exercises, speed, correlation.

Introduction

Despite a large amount of research on sprint training, we still know very little about how to prepare for a high level of sprint performance. Sprint performance is highly influenced by hereditary characteristics and yearly changes in the athlete's performance. (Thomas Haugen¹, et al 2019).

An essential focus of the work of experts and trainers has been and will continue to be the incorporation of precise scientific concepts in the training process. Due to our ever-expanding experience and our wealth of modern experience, it is now abundantly evident to everyone that great results cannot be obtained without consistent attempts to go through the training process. As a fundamental requirement, the need to develop a theoretical and practical viewpoint on the training process is outlined, understanding the key component of this process and treating it in accordance with modern requirements and the actual practical settings in which our trainers and specialists work. (Luis Peñailillo., 2016). Since the vast majority of sprint-related training treatments have a confirmed positive impact on sprinting abilities, the claim is formed that sprinting performance may be easily improved with a variety of methods. Over the course of an athlete's career, their potential for sprint performance changes due to growth, maturity, training, and age. (Haugen T, et al 2018).

Training of athletes in speed should be kept in focus on the importance of each technical phase of running which is interdependent. An athlete can dominate the first starting phase and achieve maximum speed, but can the athlete keep this speed as long as possible?

Numerous studies have already conclusively shown that physical elements determined in speed running are the power and maximum strength, supported by regular technical sprint. So, it will be seen in our study the role of strength ability in the acceleration phase and achieving the maximum speed is crucial in the result of this discipline, (Young et al., 1995) ;(Delecluse et al., 1995) (Selenica. R., Quka. N, 2017)

To achieve maximum speed, one must distinguish between the speed of moving as an indicator of the quality and speed running as a physical skill. Achieving maximum speed is possible through optimal coordination of the stride length and frequency (Cronin & Hansen., 2005).

The methodology of the training process aimed to improve sports results in speed competition continuously. The most recommended methods include low loads but with a large number of repetitions, where the loading stimulus enhances the development of speed and coordination but also running kinematics movement. (Martínez-Cava, A., et al 2019) (Sarabia JM., et al 2017). With the implementation of these methods, researchers recommend the use of training equipment such as parachutes, running with weights, and

weight vests which swing in the development of acceleration and explosive movements. Using methods with low loads have an impact not only on improving the speed of running but also improve muscle strength development (Delecluse et al 1995); (Cronin et al., 2008).

According to the authors, increase strength and power parameters are the main elements of performance speed running improvement influencing all technical stages of running speed. The importance of strength training should be focused not only to enhance performance as physical skills but is very important transmitting strength performance into speed skills (achieving and maintaining maximum speed in the distance) (Faigenbaum et al., 2007) (Selenica. R, 2016).

Speed athletes prefer more cyclic exercises that are similar to the main movement of their own discipline compared to exercises that require movement of the body in space (Mero & Komi 1994). The successful achievement of the performance in speed running is dependent on the level of power and speed indicators that the athlete can perform. (Selenica.R., Quka. N, 2016). The athlete should develop as much force as he can for a short time, especially at the phase of contact with the ground (Zatsiorsky 1995). Zatsiorsky states that 0.4 seconds is the time necessary where an athlete can achieve maximum muscle strength, but it does not mean that the same force will be transmitted at the speed of running. (Zatsiorsky& Kraemer, 2006) ;(Taylor & Beneke, 2012). The development of running speed performance requires specific training in strength and power knowing that these components have a correlation between them (Wilson et al., 1993). Improvement of power and strength promotes the recruitment and synchronization of fast motor units affecting neuromuscular stimulation and thus will improve the interaction between synergist muscles, by inducing the improvement of speed running performance (Carroll T.J., et al (2001). Planning loads that cause neuromuscular activation should be standardized to optimum loads between >30 and 70% of 1RM in order to enhance power production. (Marco A Soriano., 2015). In view of the information on load norming mentioned above, it is crucial for coaches to plan training loads in order to get the desired outcome. Sprint running training load is influenced by a number of elements, including the kind of training (sprinting/running, strength training, plyometric training), length, intensity, rest intervals, session rate, and external influences. (Lee J., 2019).

As stated above, is clear and authenticated that there is a strong correlation between the strength indicators and the speed of running. Based on the purpose of this study obtained in experiment 3 (three) training methods is to highlight which of these methods will affect more on the improvement of the running speed on all its technical stages.

The purpose of the study

To analyze the importance and the correlation of strength components such as maximal strength, maximal power, and explosive power adapted to various methods of training on their impact at the speed of running.

Material & methods

Literature review: This literature was selected by different research sectors that are based on the internet like as "JabRef" "Pub Med" "Google scholar" "Medline" and "And Sport discuss" taking into consideration stated data on scientific research articles published in different conferences and particularly on "Journal of Strength and Conditioning Research" and "Journal of Physical Education and Sport".

Selection of the subjects: Our study is focused on 80 subjects, students of the "Sports University of Tirana" where 40 students were males and 40 females. All subjects agreed to participate by free will maintaining their name anonymous. Students were separated into 4 groups, 20 students in each group. The average age of participants was 19-20 years. Three of these were experimental groups (strength group; power group; plyometric group) and one was the control group. In our study participated only those who weren't involved in other physical activities or sports to exclude other training loads impact.

Measuring Instruments: In order to collect data for strength, power, jumping skills, and speed running are used these measuring instruments are:

- Brower Timing Systems 2010, which is built to be applied as a measuring system to assess the time and speed of movement. In our study it was used for testing the speed of running at three distances 0-30m, 30-60 m, and 60 m.
- Leonardo Mechanography® GRFP standard variant of STD is an instrument that measures the weight, strength, power, speed of response from the platform, and the height of the jump in (cm) considering the center of gravity displacement for the lower limb movements.
- Isotonic Force Dynamometer "Easytech" is an instrument that measures muscle strength and the r in two ways dynamic (isotonic) and static (isometric) movements.

The methodology of tests performed:

The study is conducted for a 6-month period of the academic year including the time of subject selection, testing time, and the experiment. The duration of the tests and the retest varied for two weeks. Testing and retesting were performed in the same ways and conditions.

The four groups developed tests to measure the indicators:

- 60m test of running speed, where it was measured at the same time speed of running for 0-30m + 30-60m.
- Vertical jumping tests, with and without arm swing, (S2LJ: single two (2) Leg Jump)
- DJ (Drop Jump) H= 40 and 60 cm.
- Isotonic and isometric Muscles Strength Test.

To analyze the impact of the researched variables, we used the SPSS analytical system with different analytical techniques such as independent sample t-test and Paired samples t-test used for the t1 (before) and t2 (after) tests results. Although we have used Pearson correlation to show the interactions between two variables strength and speed running.

The experiment

In our study, we decided to experiment with 3 (three) methods of strength training programs. After the selection of subjects, they were randomly divided into 3 (three) experimental groups and 1 (one) control group. Groups were made up of 20 (twenty) subjects each. Three experimental groups performed 14 (fourteen) weeks of training with different of strength training methods. While the control group was not part of any training session. The first two weeks of the training program were used for learning and adaptation to exercise techniques. The ratio of work-rest between series and exercises was implemented at 1: 3. The planning of exercises of each of the methods of strength used is built on our research on various strength training literature. Variables loads do not change throughout the experimental phase, to avoid changes in performance as a result of the effect of load increasing progressively.

1. Method of maximal strength training that was used in the first experimental group (Strength group)

The first experimental group "strength group" conducted 2 (two) training sessions a week. Exercise's training loads are calculated from the maximum of 1 repetition, for each subject. In the first two weeks to evaluate the maximal result of 100%, we used the formula $\text{subject weight in Kg} \div (1.0278 - (0.0278 \times \text{number of repetitions}))$ (M Brzycki., 1993). We measured the load for 10 repetitions to give us a 100% of the load (M Brzycki., 1993). After that, these loads in 100% of 1 repetition were calculated by testing at maximum strength. The exercises that we used with this group were: squats; deadlifting; bench presses; calf presses.

2. Method of power training that was used in the second experimental group (Power group)

The second experimental group "Power Group", conducted 3 (three) training sessions per week, using one exercise. The characteristic of these exercises used for this group was the ratings of the loads by body weight.

- First session: Exercise 1. Resisted running weights with 20% of the body weight. Training loads 8 x 40m.
- Second session: Exercise 2. Squats in 900 performed in Smith machine, training loads 6 x 8 x 60% of body weight. It was requested that the exercise should be executed as fast as they can. (Explosive movement).
- Third session: Exercise 3. Vertical jumping with weight, training loads 6 x 8 x 50% of body weight.

3. Method of plyometric training that was used in the third experimental group (Plyometric group)

The third experimental group "Plyometric group" is trained twice a week, with two exercises per session. To implement this program were applied 40-60-80- cm platform. The intensity of performing these exercises was required in maximum value, which was measured by movement speed, where the 1-st exercise intensity was measured by contact time, while the 2-nd exercise intensity was measured by distance. These exercises were:

- Depth jumping with two legs. Training loads of exercise 3 x 10 x 60 / 80cm.
- Repeated jumps on one leg starting over a 40cm platform. Training loads of exercise: 15 x 3 with the right and left leg each.

Results

Variables that are taken in our study are:

1. Distances measured in meters/second and second: 30-meter; 30-60meter;60meter.
2. Units of force muscle, measured from lab tests: Height of jumping from Single two leg jump without arm swing (HJ-S2LJ). Height of jumping from Single two-leg jump with arm swing (HJ-S2LJ-with arm). Contact time in drop jump from 40cm.

Contact time in drop jump from 60cm. Peak torque (P-torque-right) (highest muscular force output similar to a one repetition maximum effort in isotonic. Peak torque(P-torque-left) (highest muscular force output similar to a one repetition maximum effort in isotonic. Maximum torque (Max-torque-right) maximal muscular force output is similar to one-repetition maximum effort in the isometric test. Maximum torque (Max-torque-left) maximal muscular force output is similar to one-repetition maximum effort in the isometric test.

Maximum power (Max-power- right) is how effectively the muscle can perform work over time. Maximum power (Max-power- left) is how effectively the muscle can perform work over time.

The collected data were analyzed on the mean value of the group for all variables taken in the study running. According to the data obtained from laboratory tests, the results are as follows: Running speeds measured in seconds and meters/second, showing the improvement of average speed values in meters/second.

Table I. Summary results of running speed on mean values and percentages changes for distance 0-30m ;30m - 60m; 60m

STATISTICAL ANALYSES T-TEST		MEAN VALUES CONTROL GROUP			MEAN VALUES STRENGTH GROUP			MEAN VALUES POWER GROUP			MEAN VALUES PLYOMETRIC GROUP		
		sec	m/sec	% Improve ment	sec	m/sec	% Improve ment	sec	m/sec	% Improve ment	sec	m/sec	% Improve ment
Pair 1	0-30m - t ₁	4.93	6,12	0.32%	4.75	6,36	6.9%	4.69	6,4	6.25%	4.79	6,3	4.7%
	0-30m - t ₂	4.90	6,14		4.44	6,80		4.44	6,8		4.60	6,6	
Pair 2	30-60m - t ₁	4.33	7,04	-0.56%	4.11	7,40	4.05%	4.03	7,53	5.54%	4.21	7,32	3.96%
	30-60m - t ₂	4.35	7,01		3.96	7,0		3.82	7,95		4.06	7,61	
Pair 3	60m - t ₁	9.24	6,57	-0.45	8.86	6,8	6.02%	8.65	7,0	6.57%	9.01	6,79	3.53%
	60m - t ₂	9.28	6,54		8.41	7,21		8.11	7,46		8.70	7,03	
		p>0.05			p<0.05			p<0.05			p<0.05		

The chart below shows the results of running speed in meters/second, comparing them between the experimental groups and the control group. The training methods used in each group have shown an impact in improving the running speed.

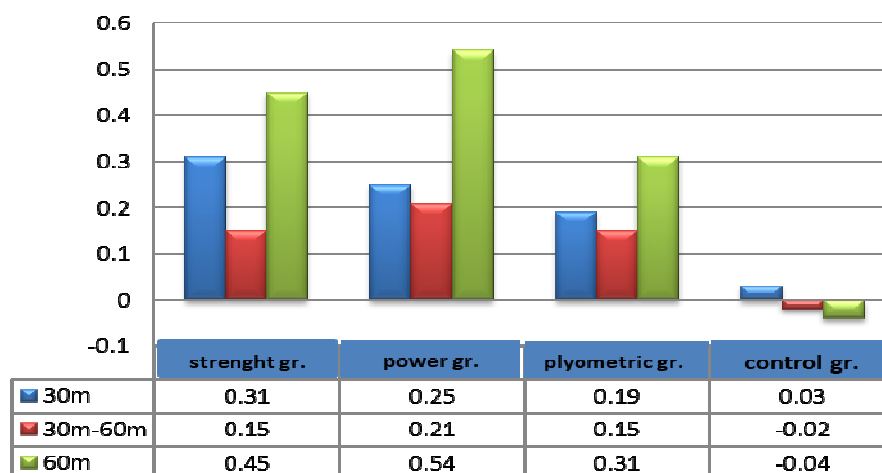


Chart I. The results of running speed at the distance measured for each group.

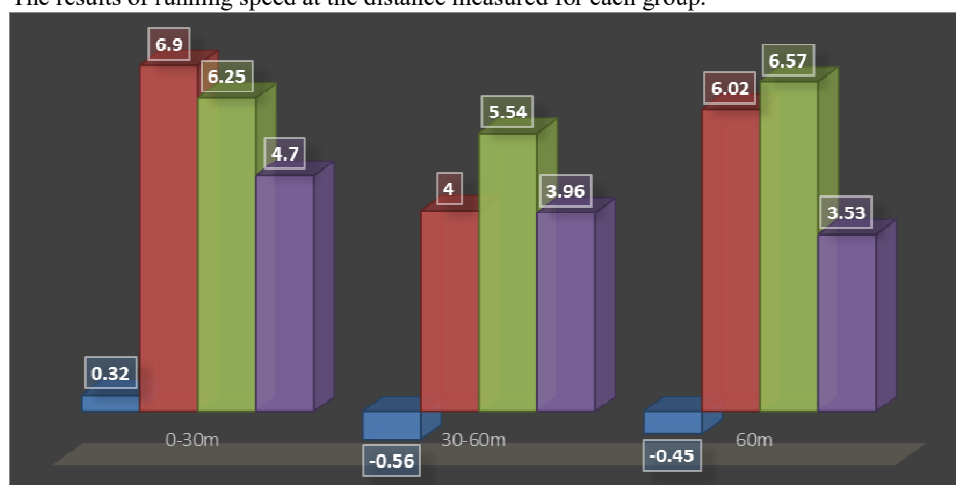


Chart II. Graphical presentation of the percentage of improvement of speed running in m/sec for the control group and experimental groups.

Based on fig I; chart I & chart II. For the first distance of 0-30m, the Strength group has shown more impact on the improvement of speed of running, which improved by 6.9% m/sec, resulting in decreased time with 0.31sec. The power group improves speed running with 6.25% m/sec, resulting in a decreased time of 0.25 sec. The plyometric group improves speed running with 4.7% m/sec, resulting in decreased time with 0.19 sec. The Control group has shown no significant results for $p < 0.05$.

For the second distance, 30-60m: the Power group showed more impact on improving speed running, where improvement with 5.54% m/sec, resulted in decreased time in 0.21 sec. The strength group improves speed running with 4.05% m/sec, resulting in decreased time in 0.15 sec. The plyometric group improved with 3.96% m/sec, resulting in a decreased time of 0.15 sec. The Control group has shown no significant results for $p < 0.05$.

For 60m distance: Power group showed more impact on improving speed running, where improvement with 6.57% m/sec, resulting in decreased time in 0.54 sec. The strength group improves speed running with 6.02% m/sec, resulting in decreased time in 0.45 sec. The plyometric group improves speed running with 3.53% m/sec, resulting in decreased time in 0.31 sec. The Control group has shown no significant results for $p < 0.05$.

Chart II shows the comparison of the mean value changes in running speeds in meters/second between the experimental groups and the control group. According to this graph, it is seen that mean running speeds in m/sec for the first distance of 0-30m are higher in the strength group followed by the power group, and finally by the plyometric group. For the second distance measured 30-60m it is seen that the highest values were achieved by the power group followed by the strength and plyometric group. For the full distance measured 60m the highest values were achieved by the power group followed by the strength group and finally by the plyometric group. So, the first distance of 0-30m has dominated the method of maximal strength training used in the strength group. For the second distance 30-60m there is dominated by the method of maximum power training used by the power group and at the third distance, 60m both methods of maximal strength and maximal power training have dominated the improvement of running speed at mean values in m / sec. The following were evaluated strength variables on their percentage improvement and significant values for $t_1 - t_2$, comparing with the control group to see the importance of training methods and their impact on the speed of running.

Table II. T-test analysis of strength indicators from t_1-t_2 and their improvement in percentages for the Control group

t-test t ₁ -T ₂									
Control group		Paired Differences N=20					t	Improvement on % from t ₂ -t ₁	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
	t ₁ - t ₂	Mean	Std. Deviation	Std. Error Mean	Lower r	Upper			
Pair 1	P-torque-right	-0,55	17,97	4,02	-8,96	7,86	-0,14	0,34	0,89
Pair 2	P-torque-left	-4,25	11,85	2,65	-9,80	1,30	-1,60	2,69	0,13
Pair 3	Max-power- right	1,20	34,21	7,65	-14,81	17,21	0,16	-0,42	0,88
Pair 4	Max-power- left	-5,65	22,32	4,99	-16,10	4,80	-1,13	2	0,27
Pair 5	Max-torque- right	-3,20	17,88	4,00	-11,57	5,17	-0,80	2,9	0,43
Pair 6	Max-torque- left	0,35	8,99	2,01	-3,86	4,56	0,17	-0,32	0,86
Pair 7	H-jump-without -arm	0,01	0,03	0,01	-0,01	0,02	1,25	0	0,23
Pair 8	H-jump-with-arm	0,00	0,03	0,01	-0,01	0,02	0,55	0	0,59
Pair 9	Contact time from H-60cm	0,00	0,02	0,00	-0,01	0,01	-0,13	0	0,90
Pair 10	Contact time from H-40cm	-0,02	0,05	0,01	-0,04	0,01	-1,40	10	0,18
								1,72%	

Table III. T-test analysis of strength indicators from t_1-t_2 and their improvement in percentages for the Strength group.

T-TEST T1-T2									
Strength group		Paired Differences N=19					t	Improvement on % from t2-t1	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		t1 - t2	Mean	Std. Deviation	Std. Error Mean	Lower			
Pair 1	P-torque-right	-29,95	0,23	0,05	-30,06	-29,84	-569,00	16,47	0,00
Pair 2	P-torque-left	-18,95	6,59	1,51	-22,12	-15,77	-12,54	10,71	0,00
Pair 3	Max-power- right	-20,21	15,49	3,55	-27,67	-12,75	-5,69	6,34	0,00
Pair 4	Max-power- left	-41,42	37,05	8,50	-59,28	-23,56	-4,87	13,49	0,00
Pair 5	Max-torque- right	-19,95	1,81	0,42	-20,82	-19,08	-48,05	16,07	0,00
Pair 6	Max-torque- left	-22,63	32,12	7,37	-38,11	-7,15	-3,07	20,32	0,01
Pair 7	H-jump-without -arm	-0,08	0,00	0,00	-0,08	-0,08	-153,00	21,05	0,00
Pair 8	H-jump-with-arm	-0,10	0,01	0,00	-0,11	-0,10	-43,14	22,73	0,00
Pair 9	Contact time from H-60cm	0,03	0,05	0,01	0,01	0,05	2,66	-13,64	0,02
Pair 10	Contact time from H-40cm	0,02	0,01	0,00	0,01	0,03	7,60	-9,52	0,00
								15.03%	

Table IV. T-test analysis of strength indicators from t1-t2 and their improvement in percentages for the Power group

T-TEST T ₁ -T ₂									
Power group		Paired Differences N=20					t	Improve ment on % from t ₂ -t ₁	Sig. (2- tailed)
					95% Confidence Interval of the Difference				
		t ₁ -t ₂	Mean	Std. Deviation	Std. Error Mean	Lower			
Pair 1	P-torque-right	-37,00	25,98	5,81	-49,16	-24,84	-6,37	30,55	0,00
Pair 2	P-torque-left	-22,80	22,36	5,00	-33,27	-12,33	-4,56	14,19	0,00
Pair 3	Max-power- right	-34,05	33,71	7,54	-49,83	-18,27	-4,52	11,25	0,00
Pair 4	Max-power- left	-40,65	45,47	10,17	-61,93	-19,37	-4,00	14,24	0,00
Pair 5	Max-torque- right	-31,40	32,45	7,26	-46,59	-16,21	-4,33	24,80	0,00
Pair 6	Max-torque- left	-18,35	21,85	4,89	-28,58	-8,12	-3,76	15,00	0,00
Pair 7	H-jump-without -arm	-0,03	0,04	0,01	-0,05	-0,01	-2,74	7,89	0,01
Pair 8	H-jump-with-arm	0,03	0,30	0,07	-0,11	0,17	0,42	-5,77	0,68
Pair 9	Contact time from H-60cm	0,03	0,08	0,02	-0,01	0,06	1,62	-13,60	0,12
Pair 10	Contact time from H-40cm	0,00	0,04	0,01	-0,02	0,02	-0,17	0	0,87
								13.72%	

Table V. T-test analysis of strength indicators from t1-t2 and their improvement in percentages for the Plyometric group.

T-TEST T ₁ -T ₂									
Plyometric group		Paired Differences N=19					t	Improvement on % from t ₂ -t ₁	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	P-torque-right	-14,89	24,44	5,61	-26,67	-3,12	-2,66	11,13	0,02
Pair 2	P-torque-left	-15,00	17,08	3,92	-23,23	-6,77	-3,83	8,91	0,00
Pair 3	Max-power- right	-13,05	28,61	6,56	-26,84	0,74	-1,99	4,32	0,06
Pair 4	Max-power- left	-25,26	29,58	6,79	-39,52	-11,01	-3,72	8,43	0,00
Pair 5	Max-torque- right	1,11	12,06	2,77	-4,71	6,92	0,40	-0,91	0,69
Pair 6	Max-torque- left	-2,63	15,64	3,59	-10,17	4,91	-0,73	2,37	0,47
Pair 7	H-jump-without -arm	-0,04	0,04	0,01	-0,05	-0,02	-4,09	8,11	0,00
Pair 8	H-jump-with-arm	-0,10	0,02	0,00	-0,10	-0,09	-26,52	20,83	0,00
Pair 9	Contact time from H-60cm	0,02	0,02	0,00	0,01	0,02	4,02	10	0,00
Pair 10	Contact time from H-40cm	0,00	0,03	0,01	-0,02	0,01	-0,42	10	0,68
								8.3%	

Based on the results of Table 3,4,5, on speed running result and strength indicators improvement we can say that:

The strength group improvement of strength indicators in mean value was 15.03% this improvement of strength indicators has been expressed in the change of speed running for distance to 0-30m by 6.9% m/sec and 0.31 sec. For distance, 30-60m speed running changed by 4.05% m/sec and 0.15 sec. For distance, 60m speed running changed by 6.02% m/sec and 0.45 sec.

The Power group improvement of strength indicators in mean value was 13.72% this improvement of strength indicators has been expressed in the change of speed running for distance to 0-30m by 6.25% m/sec and 0.25 sec. For distance of 30-60m speed, running changed by 5.54% m/sec and 0.21 sec. For distance, 60m speed running changed by 6.57% m/sec and 0.54 sec

The plyometric group improvement of strength indicators in mean value was 8.3% this improvement of strength indicators has been expressed in the change of speed running for distance to 0-30m by 4.7% m/sec and 0.19 sec. For distance of 30-60m speed, running changed by 3.96 % m/sec and 0.15 sec. For distance, 60m speed running changed by 3.53% m/sec and 0.31 sec.

Discussion

We can conclude that all the experimental groups have shown improvement in the maximal force parameters, but the better result is when the participants exercise with a training program that is similar to the testing exercises in a movement scheme and muscular tension. Taking into consideration that the exercises of the strength group are nearer to the scheme and tensions produced in testing maximal force, the improvement in this group is higher.

With great interest for our study has been the evaluation of the improvement of the result for 30 m running speed for every group involved in the study. Comparing the results, we can evaluate that the strength group has better results than the others. It is very interesting to affirm that the improvement in the time in the 30m run from starting position has the same trend as the results in the maximal force. (Selenia R., et al 2016).

It means that this conclusion is in line with the conclusion of many other studies that have pointed out maximal strength as the most influential parameter of strength for the 30m start run. It means that the capacity of acceleration is greater when the athlete has a high level of maximal strength. (Selenica. R., Quka. N, 2017) Another interesting point of study concerns the results for 30 to 60m distance. The data we have collected from the three groups show that for this distance the most effective exercises have been those comprised in the training program of the Power group. Although the differences are not very significant the fact that the improvement in maximal power influences greatly the acceleration level near the maximal speed, is in the same trend as the findings of different studies, demonstrates that the greater the dynamicity of the movement in the speed runs the greater is the influence of the power compared with the maximal force.

As a general conclusion, we can say that the maximal force level has a greater influence on the starting moment and the first acceleration phase from 0 to 30 m, and the maximal over starts to have a greater into in the second part of the 60 m run when the speed is near to the maximum, the contact time with the ground becomes smaller. (Selenica.R., Quka. N, 2016).

Although the group that has been trained with plyometric exercises is not prevalent in these two distances, compared with the other two experimental groups, the fact that there is an improvement in the distance from 30 to 60 m run by the members of this group makes us able to confirm that even these exercises have a positive influence in improving the speed parameters.

When we evaluate the results in the 60m run we can see that the Power group has greater efficiency in the training process the difference is not very significant but still gives us the possibility to conclude that the maximal power shows greater influence in improving the result in the 60m speed run. Also in this parameter, the training program of the Plyometric group has less impact on the improvement of the 60m, run time. (Selenica. R., Quka. N, 2019). Plyometric exercises have shown that they do not have a direct effect on improving the level of strength, whereas the latter has shown a correlation with the improvement of running speed. Their application would be to improve other indicators of strength such as elastic strength, neuromuscular explosiveness performance, and speed of change-of-direction ability. (Margaritopoulos, S., et al 2015) (Christos Ioannides., et al 2020). (Pedro Pinheiro Paes., et al 2022)

Taking into consideration the findings of other studies that recommend training exercises with the use of training equipment such as parachutes, running with weights, and weight vests, that improve the capacity of acceleration and explosive abilities (Delecluse C., et al 1995). (Cronin J., et al 2008).

Conclusions

As conclusions of this analysis, we can affirm:

Balancing in the right way the improvement of different parameters of strength and power is very important for a better result in the training process.

This importance consists in:

- The need for spending time and energy in greater efficiency. If we don't take into consideration this aspect, we may spend time and energy on training parameters that we don't need for a given result.
- If we exceed in developing a parameter, we can negatively influence other parameters.

The development of maximal strength is the key to developing athletic capacities but muscular power is also very important. Assessing the right process of training is essential for positive results. The alternation of the training components as volume, intensity, technical scheme, density, and time for recuperation exercises must be the focus of the trainer in order to reach the goals of the training process.

The specificity of the exercises and the programming of the external loads must be taken into consideration as essential elements for improving the specific parameters needed in a specific discipline. In our study, we proved that the specific exercise is the key to the improvement of the results.

Improvement of strength happens to the muscles that we train and it happens in the way we train them. That is why we suggest taking into consideration that the training process must be specified according to the model of movement, speed of muscular contraction type of contraction, and biomechanical scheme.

Strength training plays an important role in sprint performance. It is strongly affirmed in our study that strength and power are the most important physical parameters influencing speed.

The utilization of the proper training methods for the development of muscular strength is crucial the coach must take into consideration that maximal strength, power, and speed are closely connected to muscular capacities, being developed from the same neuromuscular system.

It is very important for the efficiency of the training process to focus on the balance between the specificity of the running speed and the nonspecific parameters. This means that we must understand and use the influence of the strength exercises over the specific technical scheme of running at maximal speed.

Plyometric exercises are more and more present in the training process of developing maximal speed. Plyometric exercises can be integrated well to provide another stimulus to the muscular system, even if they did

not perform as well as the maximum strength exercise program and the power exercise program in our experiment. We may reach the conclusion that maximal strength exercises and power exercise programs are highly received and have a significant impact on the development of running speed.

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