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THE ROLE OF ISOINERTIAL TRAINING IN IMPROVING LOWER LIMBS STRENGTH

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Abstract: *The role of isoinertial training in improving lower limbs strength is the aim of this study, because, although the place and the role of isoinertial training is still debated in specialized literature, in practice it is gaining more and more consideration.* ***Methods****. We used the CMJ test from Optojump as a measurement method, and the intensive training was carried out over a period of 12 weeks with Romanian sprinters (N=10). As a way of comparison, the test, retest method was used. During the training, modern devices were used to monitor the training of Romanian sprinters, by introducing a device that acts mainly on the eccentric strength. The data were processed using the SPSS program.*
Significant statistical differences were found in the value of the height of the vertical jump (CMJ), (Z= 3.51, p=0.00).

Key words: *isoinertial training, Optojump, Romanian sprinters.*

1. Introduction

The concept of isoinertial training using flywheel devices has been developed in the recent past, with the first evidence supporting its effectiveness as a conditioning method dating back to the early 1990s [5], this study suggesting that increases in peak torque and performance parameters related to strength were greater following a program consisting of maximal concentric and eccentric muscle actions than resistance training using only concentric muscle actions. Because the increases in muscle fiber areas were small, it is also suggested that the increase in muscle strength demonstrated following short-term adapted resistance training is mainly due to neural adaptation [8].

Wheel exercises were originally proposed to alleviate neuromuscular dysfunctions and concomitant muscle atrophy of the musculoskeletal system in astronauts caused by the absence of gravity during long-duration space travel [15].

Beato & Dello Iacono, in 2020, stated that the implementation of flywheel exercises, in special in the training of performance athletes requires some precise

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recommendations and a systematic approach and not an indiscriminate takeover of this type of training and applied in any kind of sport, and the research obtained in this regard can form the basis of work programs involving isoinertial training [2].

Contemporary literature suggests that flywheel training as a valid alternative to traditional resistance training methods, but the evidence is not particularly strong [12], [17]. Flywheel exercise vs. resistance exercise is analyzed throughout almost all studies involving isoinertial training [14], [1].

This practical method of quantifying isoinertial resistance training could be useful to athletes to help monitor training.

2. Method

We chose the CMJ test from Optojump (Microgate) to identify explosive strength in the lower limbs. The (CMJ) test is a simple, practical, valid and highly reliable test for the assessment of lower explosive strength. The vertical jump (CMJ) is one of the most popular tests to monitor an athlete's lower body muscle strength [13].

The basic research was carried out for 12 weeks and involved the application of the work program in the training of Romanian sprinters, its structure being adapted according to the competition category and the individual work plan with the device KBox4.

The subjects of the research are 10 Romanian athletes, aged between 16-25 years, who have been practicing athletics for at least 10 years and compete in the sprint events (100m and 200m).

They agreed to participate in this research and followed the established protocol, being able to withdraw from the experiment at any time, according to the consent statements.

The research sample was evaluated before and after the application of the work programs and they constantly received objective feedback as a result of the use of modern technology in training monitoring. During the research, the ethical provisions of the research, included in the Declaration of Helsinki, were also respected.

Thus, in addition to the classic means of training, modern devices were used to monitor the training of Romanian sprinters, but there was also intervention on the means aimed at the development of strength in the lower limbs, by introducing a device that acts mainly on the eccentric strength.

3. Results

Descriptive statistics Table 1

	CMJ (H-cm) T1	*CMJ (H-cm) T2*	*CMJ (Fl.-s) T1*	*CMJ (Fl.-s) T2*
Mean	50.2	56.1	0.62	0.67
Std.Dev.	8.21	8.36	0.08	0.04
Min.	34.80	41	0.53	0.58
Max.	61.20	67.2	0.77	0.77
Skewness	-0.31	-0.17	0.45	-0.82
Kurtosis	-1.1	-1.09	-0.50	-0.9

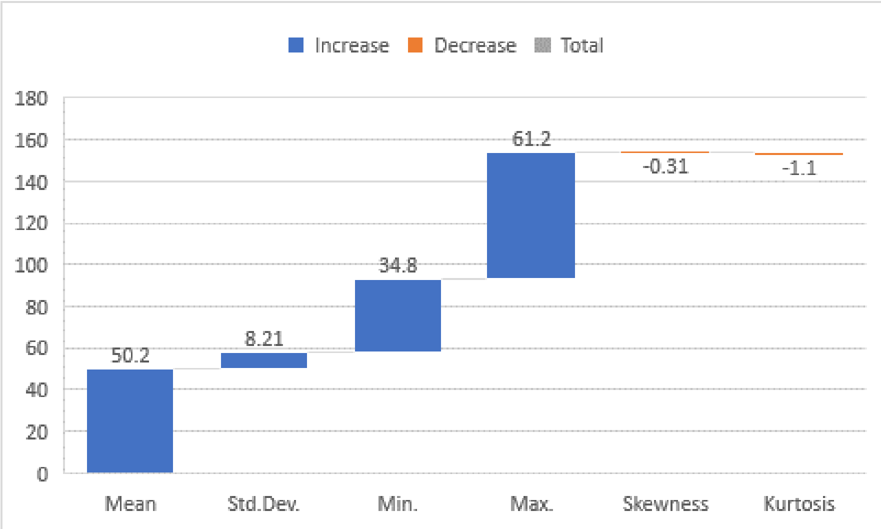

Fig. 1. *Descriptive statistics*

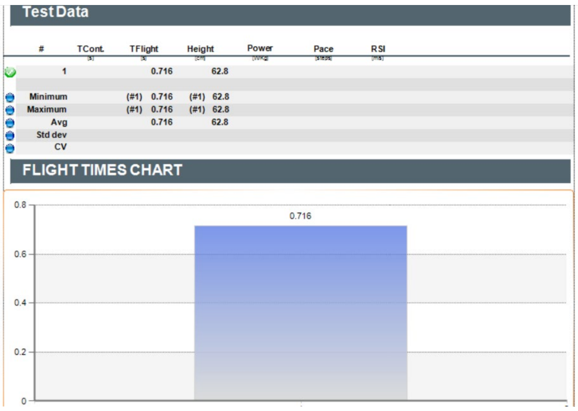

Fig. 2. *Image of the flight times chart (Optojump)*

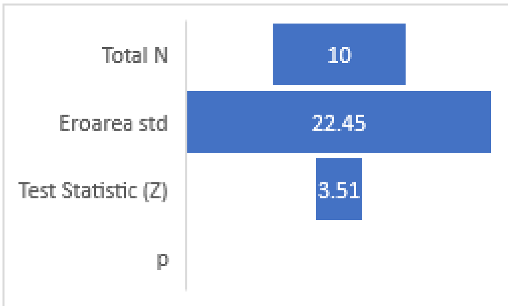

Fig. 3. *Wilcoxon Test H-CMJ-T1-T2*

Wilcoxon Test H-CMJ-T1-T2 Table 2

Total N	**10**
Std error	**22.45**
Statistical Test (Z)	**3.51**
p-value	**.000**

Explosive force testing with the OPTOJUMP device recorded an average value of 50.2 (±8.21cm) in the initial test, with values between 34.8 cm and 61.2cm and in the final test, the mean was 56.1 (±8.02cm), the results being between 41 and 67.2cm seconds. Skewness indices indicate a negative skew in the data (S<0) and Kurtosis indices show a flat distribution of the data (K<3).

The flight during the jump recorded an average value of 0.63 (±0.08s) in the initial test, with values between 0.53 and 0.77s, and in the final test, the arithmetic mean was 0.67 (±0.04s), the results being between 0.58 and 0.77 seconds. Skewness indices indicate a negative skew in the data (S<0) and Kurtosis indices show a flat distribution of the data (K<3).

Applying the Wilcoxon rank sum test to identify if there are significant differences between the values recorded at the initial and final testing of the explosive strength. identified by the height of the vertical jump (CMJ), a value of Z= 3.51 (Table 2) is observed, which is at a p=0.000, a value that statistically validates the applied work program.

3. Discussions

In our study, there were significant improvements in explosive strength (CMJ) values with the Optojump software, the non-parametric Wilcoxon test statistically validating the impact of the work program based mainly on isoinertial training on this parameter (Z=3.51, p =0.000). the modernization of the training process becomes imperative in predicting long-term sports performances, access to modern technology not being easy in Romania, at the level of sports clubs. Without a technology of the training process and without a correct and scientific monitoring of the preparation and the competition, Romanian athletes will not be able to compete on equal terms with foreign athletes who benefit from modern training devices, high-performance equipment, but also psychological monitoring.

At the same time, isoinertial training, which emphasizes the eccentric phase of the movement, applied in our research through the Kbox4 device, led to an improvement in the level of force manifestation in the lower limbs.

Another research also used a flywheel inertial device during the execution of specific soccer exercises. The isoinertial training lasted a month and a half and 34 junior football players participated in it. All the variables registered both in the test and in the pretest identified improvements in the participating athletes and emphasized the fact that using an isoinertial device to overload multidirectional movements in specific sports conditions leads to higher performance than conventional training. Skills like accuracy and speed are definitely improved by isoinertial training [7].

Another study involved 40 physically active students and proposed an isoinertial training with them, which involved 12 sessions of squats with the lower leg. The resistance was imposed by an electrical device. Their results were positive, namely that the device with a flywheel or an electric motor induced significant increases both in muscle mass and strength, but also in the students' vertical jumps [11].

Another research proposed two months of high-intensity training and isoinertial training on muscle mass and metabolic syndrome risk factors (N=12). The sample was composed of healthy adults. The isoinertial training proved to substantially increase the muscle strength and contributed to the increase of the subjects' quality of life [3].

Another study aimed to analyze the evaluation of isoinertial capacity on the effects of training. The researchers divided a sample of 24 adults into 3 groups, a maximum intensity training group, a group that performed a medium intensity training and a control group. An isoinertial dynamometer was used to evaluate the speed and power at four increasing loads. Isoinertial evaluation demonstrated for both training groups significant gains in each variable measured, so these programs can successfully be used together [10].

Another research included 60 amateur athletes and tested isoinertial training techniques. The tests consisted of lifting four different weights as quickly as possible and were carried out within a week time, test- retest. The results indicated differences in terms of speed, which improved, while power remained constant. The authors' recommendation is to monitor the relationships between force, speed and power [9].

Canós, in 2022, conducted a research on isoinertial training on young tennis players. Tests at baseline, week 4 and 8 included: counter movement jump (CMJ); speed, agility and medicine ball throws overhead. The results of the research were that carrying out these interventions, especially after the technical-tactical sessions, they could interpose additional beneficial results and the initial gains could be affected [4].

30 performance athletes were involved in a study in which their countermovement jumping performance was measured 4 times, at several times of the day. Significant differences were found in improvements in all the specific indicators in the after lunch and hours not necessarily in the morning. These results could be taken into account in the choice of training hours, as well as of the hours of the games [16].

Future research is needed to determine directions in order to gain an objective consensus on the methodological aspects of isoinertial training, so that this becomes a common language in both research and sport, regardless of the performance level and with the specifics of each sport separately [6].

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References

1. Annibalini, G., Contarelli, S., Lucertini, F., et al.: *Muscle and systemic molecular responses to a single flywheel based iso-inertial training session in resistance-trained men.* Front. Physiol., Vol. 10, 2018, p. 554, DOI: 10.3389.
2. Beato, M., Dello Iacono, A.: *Implementing flywheel (isoinertial) exercise in strength training: current evidence, practical recommendations, and future directions.* Frontiers in physiology, Vol. 11, 2020, p. 569.
3. Bruseghini, P., Calabria, E., Tam, E., et al.: *Effects of eight weeks of aerobic interval training and of isoinertial resistance training on risk factors of*

cardiometabolic diseases and exercise capacity in healthy elderly subjects. Oncotarget, Vol. 6, 2015, p. 16998.
4. Canós, J., Corbi, F., Colomar, J., et al.: *Effects of isoinertial or machine-based strength training on performance in tennis players*. In: Biology of Sport, Vol. 39, 2022, p. 505-513.
5. Colliander, E. B., Tesch, P. A.: *Effects of eccentric and concentric muscle actions in resistance training.* In: Acta physiologica scandinavica, Vol. 140, 1990, p.31-39.
6. Douglas, J., Pearson, S., Ross, A., et al.: *Eccentric exercise: physiological characteristics and acute Responses*. In: Sport. Med., Vol. 47, 2017, p. 663–675. DOI: 10.1007.
7. Fiorilli, G., Mariano, I., Iuliano, E.,.et al.: *Isoinertial eccentric-overload training in young soccer players: Effects on strength, sprint, change of direction, agility and soccer shooting precision*. In:Journal of sports science & medicine, Vol. 19, 2020, p. 213.
8. Franchi, M.V., Maffiuletti, N.A.: *Distinct modalities of eccentric exercise: different recipes, not the same dish.* In: J. Appl. Physiol., Vol. 127, 2019, p. 881–883, DOI: 10.1152.
9. Jidovtseff, B., Croisier, J.L., Lhermerout, C., et al.: *The concept of iso-inertial assessment: Reproducibility analysis and descriptive data.* In: Isokinetics and Exercise Science, Vol. 14, 2006, p. 53-62.
10. Jidovtseff, B., Croisier, J.L., Scimar, N., Demoulin, C., Maquet, D., Crielaard, J. M.: *The ability of isoinertial assessment to monitor specific training effects*. Journal of sports medicine and physical fitness, Vol. 48, 2008.
11. Maroto-Izquierdo, S., Fernandez-Gonzalo, R., Magdi, H. R., et al.: *Comparison of the musculoskeletal effects of different iso-inertial resistance training modalities: Flywheel vs. electric-motor*. European journal of sport science, Vol. 19, 2019, p. 1184-1194.
12. Norrbrand, L., Fluckey, J. D., Pozzo, M., et al.: *Resistance training using eccentric overload induces early adaptations in skeletal muscle size.* In: Eur. J. Appl. Physiol., Vol. 102, 2008, p. 271–281. DOI: 10.1007.
13. Rago, V., Brito, J., Figueiredo, P., et al.: *Countermovement jump analysis using different portable devices: Implications for field testing.* In: Sports, Vol 6, 2018, p. 91.
14. Sabido, R., Hernández-Davó, J.L., Pereyra-Gerber, G.T.: *Influence of different inertial loads on basic training variables during the flywheel squat exercise.* In: Int. J. Sports Physiol. Perform. Vol. 13, 2018, p. 482–489. DOI: 10.1123.
15. Suarez-Arrones, L., Saez de Villarreal, E., Núñez, F. J., et al.: *In-season eccentric-overload training in elite soccer players: Effects on body composition, strength and sprint performance*. In: PloS one, Vol. 13, no.10, 2018, e0205332.
16. Taylor, K.L., Cronin, J., Gill, N. D., et al.: *Sources of variability in iso-inertial jump assessments*. In: International journal of sports physiology and performance, Vol. 5, 2010, p. 546-558.
17. Tesch, P.A., Fernandez-Gonzalo, R., Lundberg, T.R.: *Clinical applications of iso-inertial, eccentric-overload (YoYo™) resistance exercise*. In: Front. Physiol., Vol. 8, 2017, p.241, DOI: 10.3389.