DOI:10.2478/tperj-2020-0008

Impact of using modern technology in training on sports performance

Gabriel ARNĂUTU[1], Iacob HANȚIU[2]

Abstract

Introduction: The close relationship between technology and sports is not necessarily modern. The ancient Greeks had the idea of sculpting and making an extraordinarily aerodynamic object in the form of a disc, an early masterpiece that has remained largely unchanged to this day. *Purpose*: This paper aims to show the importance of monitoring training using technological tools, so as to result in a beneficial effect on athletes.
Materials and methods: In order to carry out this research, 32 athletes, boxing practitioners for at least two years, and with at least one year of preparation for participating in domestic and international competitions, were selected. Subjects were divided into two groups, one that was subjected to research (experimental) composed of 12 athletes aged 15 to 18 years, and the other composed of 20 athletes aged between 15 and 18 years.
Results: The average scores for the four parameters of the experiment group (N= 12) (Forced expiratory volume in one second (FEV1), M = 6.95, AS = 0.53; peak expiratory flow (PEF) M = 9.43, AS = 1.35; Right direct punch (MYO_DRP) M = 588.33, AS = 181.94; respectively the left direct punch (MYO_STG) M = 546.75, AS = 136.82) were significantly higher than those of the control group (N=20) (FEV, M = 5.46, AS = 1.22 ; PEF M = 7.33, AS = 1.43; MYO_DRP M = 426.55, AS = 151.68; MYO_STG M = 406.50 , AS = 139.13, respectively).
Conclusions: Based on the analysed data, we can say that our hypothesis that continuous implementation and monitoring of training plans using technological means will lead to the improvement of the indices pursued in the research, is confirmed. Thus, the group that underwent a training regime using certain technological tools recorded significantly higher values at the end of the programme in comparison with the control group. However, we could see that the use of devices during training, which require them to be fitted every time on the athlete, leads to an extension of training duration and takes the athlete out of the training state. To remove this shortcoming it would be useful to integrate these equipments into a system that incorporates them all.
***Key words**: boxing, technology, training*

Rezumat

Introducere: Relaţia apropiată dintre tehnologie şi sport nu este neapărat modernă. Vechii greci au avut ideea de a sculpta şi realiza un obiect extraordinar de aerodinamic sub forma unui disc, o capodoperă timpurie ce a rămas în mare parte neschimbată până în prezent.
Scop: Lucrarea de faţă îşi propune să arate importanţa monitorizării antrenametelor cu ajutorul mijloacelor tehnologice, astfel încât să rezulte un efect benefic asupra sportivilor.
Materiale şi metode: În vederea realizării acestei cercetări au fost selectaţi 32 de sportivi, practicanţi de box de minimum doi ani şi cel puţin un an aflaţi în pregătire în vederea participării la competiţii interne şi internaţionale. Subiecţii a fost repartizaţi în două grupe, una care a fost supusă cercetării (de experiment) compusă din 12 sportivi cu vârsta cuprinsă între 15 şi 18 ani, iar cealaltă compusă din 20 de sportivi cu vâsta cuprinsă între 15 si 18 ani.
Rezultate: Scorurile medii în cazul celor patru paramentrii pentru grupa experiment (N= 12) (Volumul expirator fortat într-o secundă (FEV_1), M = 6,95, AS = 0,53; debitul expirator maxim (PEF) M = 9,43, AS = 1,35; Lovitură directă de dreapta (MYO_DRP) M = 588,33, AS = 181,94; respectiv lovitură directă de stânga (MYO_STG) M = 546,75, AS = 136,82) au fost semnificativ mai mari decât cele ale grupei de control (N=20) (FEV, M = 5,46, AS = 1,22 ; PEF M = 7,33, AS = 1,43; MYO_DRP M = 426,55, AS = 151,68; respectiv MYO_STG M = 406,50 , AS = 139,13).

[1] Assistant Professor, Physical Education and Sport Faculty, West University of Timişoara; PhD student, University of Babeş-Bolyai, Cluj-Napoca, *e-mail:*
[2] Professor, PhD, University of Babeş-Bolyai, Physical Education and Sport Faculty, Cluj-Napoca, Romania,

Concluzii: În urma datelor analizate putem afirma că ipoteza noastră, conform căreia implementarea şi monitorizarea continuă, a planurilor de antrenament cu ajutorul mijloacelor tehnologice va duce la îmbunătăţirea indicilor urmăriţi în cercetare, se confirmă. Astfel, grupa care a fost supusă unui regim de antrenament cu ajutorul anumitor mijloace tehnologice a înregistrat valori semnificativ mai mari la finalizarea programului. Cu toate acestea am putut observa faptul că utilizarea de dispozitive, în timpul antrenamentului, care necesită montarea acestora de fiecare dată pe sportiv duc la prelungirea duratei antrenamentului şi scot sportivul din starea de antrenament. Pentru a înlătura acest neajuns ar fi utilă integrarea acestor echipamente într-un sistem care să le înglobeze pe toate.
***Cuvinte cheie**: box, tehnologie, antrenament*

Introduction

The close relationship between technology and sports is not necessarily modern. The ancient Greeks had the idea of sculpting and making an extraordinarily aerodynamic object in the form of a disc, an early masterpiece that has remained largely unchanged to this day [1]. In fact, over the years, technology and sports have had the same path.

Nowdays, it has been reached a point where technology meets the needs of sports activities in terms of safety for the athletes, and also for improving and measuring performance. [1].

Nowadays a lot of non-invasive portable devices are used continuously, including in everyday life, to monitor health, physical activity, performance assessment and for keeping track of other activities [2].

These portable devices use sensors to collect raw data that are stored and further used for continuous health monitoring, for the evaluation of physical activity and performance. Moreover, currently, there are many modular sensors that can be easily connected to any device (phone, computer) in order to collect data [2].

Hypothesis and purpose

This paper aims to show the importance of monitoring training using technological tools, which can lead to a beneficial effect on athletes.

The objectives of the research are the following:

- Optimal determination of physical effort parameters for each athlete;
- Application of individualised training plans and monitoring of their effects on athletes' performance;
- Identification of specific indices that need to be improved;
- Creating conditions conducive to the necessary physical development;
- Providing the means and materials needed for evaluation.

Our hypothesis consists of the fact that the implementation and continuous monitoring of training plans using technological means leads to the improvement of the indices pursued in the present research study.

Material and methods

In order to carry out this research, 32 athletes, boxing practitioners for at least two years and trained for at least one year to participate in domestic and international competitions, were selected. All participating athletes are members of clubs affiliated with the Romanian Boxing Federation, are registered with the clubs of provenance and have regular medical checkups. The subjects were divided into two groups, one that was subjected to research (experimental) composed of 12 athletes aged 15 to 18 years, and the other composed of 20 athletes aged between 15 and 18 years.

The research took place between January and November 2018. The initial test took place between 08/01/2018 and 13/01/2018, with athletes in preparation for the new competitive season, being in the body adaptation phase, freshly returned after a break period of about two weeks. The final testing was carried out at the end of the competition year (November 2018). In this research, the experiment method, evaluation method and statistical-mathematics method for data analysis and interpretation were used as research methods. After data collection, the SPSS software was used for descriptive analysis, data distribution and tests to verify the significance of differences between means.

The respiratory capacity assessment protocol was carried out in accordance with the procedures suggested by specialists in the field [3, 4]. Only those exhalations whose automatic quality control has been met, according to the European Respiratory Society/American Thoracic Society [5], were taken into account. The prediction method used by the spirometry software was that exhibited by the European Respiratory Society and Kudson [6]. The respiratory capacity test was performed using a portable spirometer, SpiroTube Primary produced by Thor Laboratories, Hungary. The parameters tracked in this protocol were forced vital capacity (FVC), forced expiratory volume in one second (FEV1), peak expiratory flow (PEF).

The maximum power assessment protocol was achieved through an adaptation of the Bench Press (BP) protocol using Myotest PRO, Power Analyzer. The subject was lying on his back, having the sensor attached to the grip of the glove with the arm in full

extension, performing at the first sound signal of the device a flexion of the elbow joint, and, at the second signal, the energetic extension of the arm. The subjects performed two repetitions each. The Protocol used for Squat Jump was followed according to the adaptations made by Păunescu, C., et al. 2012 [7]. Before the start of the protocol, the device emits a first beep which is associated with the triple flexion of the lower limb joints, the subject descending into the squat position with the knees bent at 90°, maintaining this position until the next signal when he has to perform a rapid extension followed by a high jump. The device emits the second beep only when the integrated sensor does not record any other movement in the longitudinal axis. The reliability of this device has been tested by Paunescu et al., 2012 [7]. The parameters monitored within the study protocol are as follows: direct right punch laying back (Myo_drp), left direct punch laying back (Myo_stg) and Squat Jump (Myo_SQ). The number of punches thrown assessment protocol was carried out in accordance with the AIBA Athlete Testing Manual [8]. The speed was measured using accelerometers produced by Hykso.

The groups included in the research followed the training plan originally established by the coaches throughout the competition year.

The athletes of the experimental group also used certain technological equipment, such as equipment for the development of inspiratory muscles (Train Air apparatus) and various accelerometers. These devices helped to schedule the workout and were always able to observe the values of the effort parameters. To monitor heart rate, athletes were equipped with Onrythm 500 pulsometers which permitted the real time rendering of the working intensity. For weight training, Beast Sensor was used. This is an accelerometer capable of quantifying workload, execution speed and (working element) repetition frequency.

Having access to the data in real time, the trainers of the experimental group were able to make changes in training planning accordingly.

Results

The data distribution test (Shapiro Wilk) was carried out and we could observe that in the case of the initial tests only one parameter did not have a normal distribution (control group, Myo_sq, p = 0.001), and in the case of the final test the abnormal distribution of the data was observed for two parameters (experiment group, FEV1 p <0.05, respective control group Myo_sq, p <0.05).

To see if there are significant differences, we used parametric and nonparametric tests between the two testing moments. Using SPSS we could observe that both training programs have seen increases in the parameters being tracked. However, the average values in the experiment group were higher than those in the control group. In the case of the independent sample test, based on the results collected in the initial test, significantly different values could be observed only for two of the followed parameters (table I).

Value	Experiment (N=12)		Control (N=20)	
	Mean	**SD**	**Mean**	**SD**
FVC	4.56	.62	4.67	.77
FEV	4.09	.47	4.23	.57
PEF	6.58	1.181	6.44	1.29
MYO_DRP*	550.83	162.75	406.50	139.13
MYO_STG*	509.25	126.97	386.45	135.60
MYO_SQ	50.99	3.03	47.77	5.39
HYKSO	46.16	3.48	44.20	3.87

Table I. Average and standard deviation from initial testing

The average scores for the experimental group (N=12) for parameters assessing strength at the time of execution of the blow (right arm M= 550.83 AS= 162.75, left arm M=509.25 AS=126.97) were significantly higher (t=2.66 , df=30 p=0.012, respectively t= 2.53 df= 30 p = 0.017) than those of the control group (N=20) (M=406.5 , AS = 139.13 , respectively M= 386.45 AS = 135.60. Performing the same tests after the training period, the experiment group recorded significant values in four of the seven parameters followed. Average scores for the four parameters for the experiment group (N= 12) (FEV, M = 6.95, AS = 0.53; PEF M = 9.43, AS = 1.35; MYO_DRP M = 588.33, AS = 181.94; respect MYO_STG M = 546.75, AS = 136.82) are significantly higher than those of the control group (N=20) (FEV, M = 5.46, AS = 1.22; PEF M = 7.33, AS = 1.43;

MYO_DRP M = 426.55, AS = 151.68; MYO_STG M = 406.50 , AS = 139.13, respectively) .

Measurement	Experiment (N=12)		Control (N=20)	
	Mean	SD	Mean	SD
FVC	7.42	.74	6.57	2.07
PEF*	9.43	1.35	7.33	1.43
MYO_DRP*	588.33	181.94	426.55	151.68
MYO_STG*	546.75	136.82	406.50	139.13
HYKSO	47.58	2.87	45.60	4.07
FEV*	6.95	.53	5.46	1.22
Myo_SQ	66.13	9.13	60.54	8.41

Table II. Average and standard deviation of final testing

We also wanted to determine the effect size for the parameters that differed significantly. Thus, in the experimental group, the effect size in the case of FEV1 = 2.34, with an improvement percentage of 41%, compared to the control group with only 29%; PEF = 1.46 with a percentage of 30% versus 14% of the control group; Myo_drp = 1.06, with an improvement percentage of 6.3%, Myo_stg = 1.00 with an improvement percentage of 6.8%, respectively [9].

Discussions

Based on the collected data, we can observe a greater response to spirometric parameters in the experimental group compared to the control. Thus, the experimental group data reveal an improvement of FEV_1 amounting to more than 40%, and of PEF by 30%, as a result of the respiratory training program associated with specific training, compared to the control group that registered below 25%. The research results are comparable with this other study that recorded FVC values = 4.82, FEV1 = 4.27, PEF = 586.21 (l/sec) (9.77 l/min) [10].

The data can be inflamed by the type of training that athletes have in the training plan, so athletes who followed a specific endurance training during the preparatory period recorded significantly higher values than those who follow a power development program in the case of spirometric parameters [11].

Durnic (2017), evaluating 40 boxers recorded values similar to those obtained in this research, noting significantly different values compared to athletes who have endurance as their specific training, stating that such training positively influences the spirometric parameters [11]. Comparing the results obtained in the Squat jump sample we can also observe values of the averages that are much higher compared to other research studies [12]. Also, regarding force, in the case of direct punches, we can observe superior differences in the case of this study [12], due to the use of a cushion equipped with accelerometers and position of execution (in our case lying back). Although, in our study, an increase in strike frequency averages could be observed in 10 seconds (M_initial = 46.16, M_final = 47.58) with no statistical significance, a finding was reported by other authors, who propose a pliometry training similar to our program [13].

Conclusions

From the analysed data we can say that our hypothesis is confirmed. Thus, the group that underwent a training regime with certain equipment recorded significantly higher values at the end of the program. However, certain particulars are required. To remove this shortcoming it would be useful to integrate this equipment into a system that incorporates them all.

References

1. Müller H., Glad B. (2012). *Technology in Athletics*, New Studies in athletics, 29(3), 7-13.
2. Kamišalic A. Fister I., Turkanovic M., Karakatic S. (2018). *Sensors and functionalities of non-invasive wrist-wearable devices: A review*, Sensors, 18 .
3. Miller M. R., Hankinson J., Brusasco V., Burgos F., Casaburi R., A. Coates, Wanger J. (2005). *Standardisation of spirometry.* European Respiratory Journal, 26, 319-338.
4. Tudorache V. M., Oancea C. (2008). *Evaluarea funcției musculare*, In V. Tudorache (Ed.), Tratat de reabilitare pulmonară, Editura Mirton, Timişoara, 234.
5. Chung K. F., Wenzel S. E., Brozek J. L., Bush A., Castro M., Sterk P. J, Teague W. G. (2017). *International ERS/ATS guidelines on definition, evaluation and treatment of severe asthma*, European Respiratory Journal, 43, 343-373.
6. Temmeling G. J. (1993). *Standardization of lung functi test*, United Kingdom: The Society and Munksgaard.
7. Păunescu C. Piţigoi G., Nicolae E., Pricop A., Păunescu M. (2012). *Fiabilitatea utilizării device-ului myotest pro în măsurarea detentei,* Discobolul - Physical Education, Sport and Kinetotherapy Journal, 30(4), 117-123.
8. AIBA. (2010). *Evaluation of boxers abilities*, 210.
9. Vincent W., Weir J. (2012). Statistics in Kinesiology, ed Human Kinetics, 110-112.
10. Ermiş E., Yulmz A.K., Mayda M. H. (2018). *Analysis of respiratory functions and respiratoru muscle strength of martial arts athletes,* International Journal of Applied exercise physiology, 8(1), 2322-3537.
11. Durmic T., Popovic B.L., Svenda M.Z., Djelic M., Zugic V., Gavrilovic T., Mihailovic Z., Zdravkovic M., Leischik R. (2017). *The training type influence on male elite athletes ventilatory function,* BMJ Open Sport and Exercice Medicine, 3.
12. Loturco I., Nakamura F., Artioli G., et al. (2015). *Strength and power qualities are highly associated with punching impact in elite amateur boxers,* Journal of strength and Conditioning Research, 30(1), 109-116.
13. Bruzas V., Sigitas K., Venckunas T., Snieckus A., Mockus P. (2015). *Efects of plyometric exercise training with external weigts on punching ability of exerienced amateur boxers*, Science of Martial Arts, 11