DOI 10.2478/afepuc-2019-0004
© Acta Facultatis Educationis Physicae Universitatis Comenianae 2019, 59(1): 33-43

THE EFFECT OF HEAVY WEIGHT TRAINING ON PHYSIOLOGICAL ABILITIES OF SOCCER PLAYERS UNDER THE AGE 21 YEARS OLD

Koutchouk Sidi Mohamed[1], Kerroum Mohamed[2], Sebbane Mohammed[2], Djamel Mokrani[1], Adel Belkadi[1]

[1]Laboratory of Programs Optimization in APS,
[2]Laboratory of Applied Sciences to Movement Human Institute of Physical Education and Sports, University of Mostaganem, Algeria

Summary: The objective of the study is to design a specialized training program in modern weighting methods for under-21 soccer players to develop muscular strength and to identify the effect of the training program on weighting exercises on some physiological variables (some aerobic and anaerobic abilities such as VO_2max heartbeat and backstage). Researchers in this study that weight training for soccer players will have a clear impact on both the development of muscle capacity and improve some functional abilities. The experimental method was used to design two samples, a experimental sample and a control sample of under-21 soccer players who were selected by a team of Mustaganem teams. Each sample consisted of 18 players. The experimental sample was applied to the weight and control program. For four months. The study showed that the experimental sample achieved a significant increase in muscle strength measurements as well as some physiological variables in all measured tests compared to the control sample. This is the result of the proposed training program applied to the experimental sample.

Keywords: heavy weight training, muscle strength, physiological abilities, Soccer players.

Introduction

Muscle strength is one of the most important skills of fitness. Those skills should be available to soccer players; they have to be strong in most large muscle samples in the body(Suchomel, Nimphius & Stone 2016), to overcome a number of factors imposed by the nature of the game on which the movement and the physical performance depends on ,in soccer practice (Halson 2014). The results of some researches and studies (Akubat, Patel, Barrett & Abt 2012; Ali 2011; Garganta 2009; Janelle & Hillman 2003), showed that muscle strength is a fundamental factor which (Carroll, 1993) develops the motor performance of soccer players, because of their association and impact to other physical abilities related to performance such as speed, endurance, agility and flexibility(Franks & Goodman 1986).

Heavy weight training has been for a long time a subject of controversy among specialists in the preparation and training of the development of muscle strength in soccer players(Zatsiorsky & Kraemer 2006). Some of them (Garganta 2009)opposed that training with heavy weights reduces their motor speed , the range of motor joints as well and causes the degree of stiffness in the muscles. As an objective means of developing the different types of muscle strength that any player needs and which helps in developing physical abilities and improving performance.

Most of the results indicated that heavy weight training has become an effective and necessary tool for development of different types of muscle strength (McBride, Triplett-McBride, Davie & Newton 2002). It has direct and essential impact on the degree of development and improvement of all elements of overall fitness which is considered to be the fundamental pillar of motor capacity and speed (Serrano, Shahidian, Sampaio & Leite 2013). Heavy weight training does not only affect the musculoskeletal system, but extends to the physiological positive effect on functional efficiency such as the heart and the circulatory and ventricular organs (Nystoriak & Bhatnagar 2018; Vigorito & Giallauria 2014). Regarding the process of heavy weight training, in the basis is a physiological process aimed at improvement of the functional efficiency of the body(Mayer et al. 2011). so its physiological effect leads to an increase of muscle inflation, which helps stimulate blood circulation and increasing blood flow and muscle retention(Kang, Lin, Kuppermann, Melero-Martin & Bischoff 2017; Loos, Opdenakker, Van Damme & Proost 2009),the wideness of capillaries, improvement of oxygen uptake (O2) and aerobic and anaerobic energy production as well (Bassett & Howley 2000; Bogdanis 2012).

Muscle strength is one of the most important physical qualities, and is considered to be an important physical characteristic, physiological ability and a dynamic element among the other physical characteristics of the soccer player (Akenhead 2014). The development of muscle strength in heavy weights in soccer is a technique based on exercises that require a rapid muscle strength in the sense of reaching maximum strength in a short period of time during implementation(Silva, Nassis & Rebelo 2015) ; but physiologically is the muscle efficiency to produce the anaerobic energy used by the player to perform strong and fast movements for few seconds(Zemková & Hamar 2018).

Many studies confirm that heavy weight training aims at improving the functional efficiency of the body and increase the size of the rib cage and the efficiency of the breathing muscles (Ali 2011; Mayer et al. 2011; Russo, Santarelli & O'Rourke 2017; Serrano et al. 2013; Silva et al. 2015). Muscle training also helps the heart to increase its activity by stimulating the blood circulation in increasing blood flow and improving oxygen utilization(Delp et al. 2001; Joyner & Casey 2015) and to improve aerobic energy production (Yousuf Lazem Kemash - Saleh Bashir Saad 2006). In fact, the Algerian soccer sport lacks of well-planned and carefully prepared heavy weight training programs such as supplementary exercises or integration into physical preparation stages. We can confirm that at least 90 % of the sports teams did not undergo any weight training programs throughout the training seasons, focused on muscle strength development , and researchers were able to determine the extent of knowledge of these trainers(Belkadi et al. 2015) about the nature of weight training. The problem is not in heavy weight training in general, but in the chosen and appropriate exercises, which are focused on suitable muscle work of a soccer player. The lack of knowledge of these changes and adaptation that occurs in the functional body systems as a result of these exercises because the scientific researches and previous studies confirm the correlation between the functions of the heart, lungs and blood circulation and the muscular system in the degree of consumption of oxygen and in the production of energy.

Methods

Participants

Thirty six soccer players were recruited for this study; The data collected was separated into two groups Experimental group EG (N = 18) and Controlled group CG(N = 18) based on their level of practice (Table 1) participated in the study after receiving a comprehensive explanation of the procedure. The study was planned according to the Helsinki Declaration

(World Medical Association 2013) and was approved by the scientific institute of sports ethics committee. Based on the accuracy results of a self-reported questionnaire (Cherara, Belkadi, Asli & Benbernou 2019), no subject had been treated with any medication or physiotherapy from severe injury during the first three months. Both teams are active in the national championship section one Algerian professional the homogeneity of the sample members was taken into account in some variables of muscular and physiological capacity, so that the procedure can be adjusted for a set of variables.

Procedures

Anthropometric data from each participant was completed by the coaching staff that regularly performed these measurements as a part of their evaluation routine. Body mass and height were respectively obtained from a Connected Scales 700 (Geonaute, France) and a Stadiometer HM200P Portstad Portable (Charder, USA).

Maximum muscle strength test (1-RM)

Diagnosing the percentages of progression of strength of different muscle samples of the experimental research sample.

- Laying down test: (Hammad 2000, p 68) to measure the strength of muscle samples of the upper limbs (chest, back, shoulders, arms).
- (Abdominal) test: (Al-washahi 1994, p 142).
- Full bending test (1/2- squat) (Cometti 1993, p 103): Measurement of strength muscles of the lower limbs (the two legs).

30 Metre Acceleration Test

The objective of this test is to monitor the development of the athlete's ability to effectively and efficiently accelerate from a standing start or from starting blocks to maximum speed.

Mini-Cooper VO_2max Test

The objective of the Cooper test is to predict an athlete's VO_2max. The test comprises of seeing how far an athlete can run/walk in 5 minutes. The assistant should record the total distance covered.

VO_2max maximum aerobic speed (VMA)

$VO_2max\ (ml.kg^{-1}.min^{-1}) = 2.27(km/H)v + 13.3.$

$VMA = 3{,}6 \times \text{distance (m)} \div \text{time (s)}.$

Where the 3.6: constant value: -distance through 5 min.

Study Design

General planning of the program

The study took into consideration that the duration of the weight-training program coincided with the preparation period for the training season (2016 – 2017) as a component of the general training program for a team. Duration of the program consisted of approximately 4 months and 3 training courses with weights of 5 training units per week - during the general and special preparation period, per week in the period of competition. The researchers took into account the principles of training in the design of the programme especially the principle of privacy and overload, adaptation, sequential measurements after each training period. To determine the new weight to be trained in the following period through the maximum weight (RM) tests with different frequency of performance appropriate for each training period where the intensity of the training increases and the frequency of repetitions decreases as the program progresses. With the development of all types of muscle strength beginning with the development of tolerance of strength and strength characteristic of speed and then explosive power, and allocated time for each training module (30 – 40 minutes).

Result

Table 1

Presentation and analyses the results of the physiological tests (pre- and post-tests) of the experimental sample

Tests	Pre- A.V	S.D	Post- A.V	S.D	Sample	Liberty degree	Significance level	Tabular T	Calculated T	Statistic. Significance
Maximum anaerobic capacity Running (30 m)	5.21	0.25	4.60	0.18	18	17	0.05	1.74	2.03	Significant
Brikci test (running 5 min). VO_2max	51.70	1.41	55.91	153					2.03	Significant
Maximum aerobic capacity. Brikci test (5 min).	17.57	0.84	19.94	0.67					2.21	Significant
Pulse (/) during rest	71.86	2.23	64.05	2.13					3.96	Significant
Ruffier for measuring capacity	11.06	3.59	9.34	1.94					3.46	Significant

Table 2

View and analyses of the results of physiological tests (pre- and post) of the control sample

Tests	Pre- A.V	S.D	Post- A.V	S.D	Sample	Liberty degree	Significance level	Tabular T	Calculated T	Statistic. Significance
Maximum anaerobic capacity Running (30 m)	5.27	0.23	4.67	0.24	18	17	0.05	1.74	4.00	Significant
Brikci test (running 5 min). VO_2max	51.17	1.16	55.28	1.13					2.55	Significant
Maximum aerobic capacity. Brikci test (5min)	17.06	0.86	19.21	0.70					1.95	Significant
Pulse (/) during rest	72.56	3.82	68.11	2.92					2.65	Significant
Ruffier for measuring capacity	11.93	2.42	10.50	2.53					2.35	Significant

Table 3

Presentation and discussion of the results of the physiological tests of the two research samples in the post-test

	Tests	Statictical Study	Samp le	Degree of liberty	Significance level	Tabular value	Calculated value	Statistical significance
Physiolgical testso	Maximum anaerobic capacity (run 30 m)		36	34	0.05	1.69	2.50	significant
	Brikci test (running 5 min) VO_2max						2.44	significant
	Maximum aerobic capacity Brikci test (5 min)						2.48	significant
	Pulse (/) during rest						2.12	significant
	Ruffier for measuring capacity.						1.93	significant

Table 3 Shows the value of calculated (T) in the post physiological tests of the two samples of the research.

Discussion

From the foregoing, within the scope of the methodology used, the proposed program and the sample applied to the study, the following conclusions were reached.

In the course of the survey, we concluded that although the trainers have long field qualifications and experience, they still lack some scientific methods and information about weight training, in addition to the opposition of many of them to these exercises on the pretext

that they lead to muscle inflation and to reduce the motor range and muscle stiffness. They do not have sufficient knowledge or information about the impact of weight training on some physiological functions such as improving heartbeat and breathing in increasing blood circulation activity in general and physical fitness in particular in increasing aerobic and anaerobic energy production (al-Mawla 1999, p. 134). The statistical results of the physiological tests showed that the experimental sample achieved the best mean for the control sample in all these measurements (maximum O_2 - VO_2max, maximum air velocity (VMA), maximum anaerobic capacity , Pulse measurement at rest, and back-to-back).

The researchers attributed this to the fact that the process of weight training in the basis of physiological process aimed at the development of muscles and improvement of the efficiency of the functional body and stimulation of the blood circulation by increasing the blood float and the wideness of capillaries and improvement of the degree of utilization of oxygen O_2 and improvement of the production of aerobic energy. And that weight training increases the chest cavity and increases the efficiency of the respiratory muscles and thus improve (maximum consumption of O_2 (VO_2max) and maximum air velocity (VMA) and also leads to the development of functional changes in the heart is the expansion of the heart cavities and increase the strength of the heart muscle and increase in size The heart and low heart rate during rest, which is an indicator of high physical fitness of the athlete. The muscular ability to make a job depends directly on the efficiency of the heart, blood vessels and lungs in supplying muscles with energy. Which leads to an increase of blood pressure to meet the high blood pressure during training and thus improve the ability to return and pulse. This is consistent with the scientific sources and some previous studies that confirm the correlation between cardiovascular function and the circulatory system and the muscular system of the benefit of O_2. DELLAL (2008) confirms that the training of muscle strength with the weights enhances the strengthening of the tendons and ligaments and connective tissue in the muscle by increasing the number of capillaries and the stock of energy substances in the muscle such as calcium and ATP-PC, The muscle system is the determining factor in aerobic efficiency and not the transfer of O_2 to the muscles. If the respiratory system supplies the circulatory system with greater amounts of O_2, it is transferred to the muscles, Muscle cannot consume all O_2 contained by the circulatory system, so that the muscular system is the largest responsible for aerobic capacity, and also called VO_2max during muscle work using 50 % of the muscles of the body (Salah 2004, p 174).

This result also helps researchers answer several questions by opposing some trainers to heavy weight training for young people on the grounds that they affect some of the maximum

anaerobic abilities and other physical attributes such as speed. Weight training is a training program to develop anaerobic ability with a wide range of soccer Based on exercises that call for rapid muscle strength in the sense of reaching maximum strength in a short period of time during implementation. One of the studies pointed out by (Serrano, Shahidian, Sampaio & Leite 2013) that certain weight training programs can lead to the development of periodic and respiratory stress by improving the efficiency of the work of the heart and circulatory system and VO_2max.

The ability to exercise directly depends on the efficiency of the heart, blood vessels and lungs in the supply of muscle energy, and increases the maximum consumption of O_2 under the influence of muscle strength exercises, especially when the use of circular training system, but this increase is not equivalent to what can be achieved through endurance training programs (AL-DDINE 2004, p 64). Therefore, we can say that the hypothesis of the research that the proposed heavy weight training program positively affects the improvement of some functions and physiological variables of soccer players have been achieved.

Conclusions

The statistical results of the physiological tests showed that both experimental and control tests achieved significant differences between the results of the pre and post test in favour of the post-test - in all measured tests (VO_2max), maximum pneumatic speed (VMA), maximum anaerobic capacity. The measurement of the pulse during rest and to return to training programs of the two samples of general preparation and training on the endurance, and through the improvement and the difference in the averages between the two samples we note that the experimental sample achieved the best average arithmetic compared to the control sample in all these The results of the study are consistent with the results of the previous studies in that the weight training process is basically a physiological process aimed at developing muscles and improving the efficiency of the functional body and activating blood circulation in increasing the blood flow and muscle density and the wideness of capillaries and improve the degree of utilization of oxygen O_2 and improve aerobic energy production, weight training increases the chest cavity and increases the efficiency of breathing muscles, thus improving the maximum VO_2max and VMA. This training also leads to functional changes in the heart, Heart, increased heart muscle, increased heart volume, decreased heart rate during rest, which is an indicator of increased physical fitness of an athlete. Muscle capacity to perform a job directly

depends on the efficiency of the heart, blood vessels and lungs in supplying muscles with energy. Which leads to increased blood pressure to cope with high blood pressure during training and thus improve the ability to return and pulse. This is consistent with the scientific sources and some previous studies that confirm the correlation between the functions of the heart and lungs and blood circulation and the muscular system of the degree of utilization of O_2.

References

1. AHMED SALAH, 2004. Effect of Proposed Program for Dynamic and Static Muscle Work on Some Physical Variables and Respiratory System Functions (Comparative Study). *ASSIUT Journal of physical Education*. The **8(**2), p. 174.
2. AKENHEAD, R. M., 2014. *Examining the Physical and Physiological Demands of Elite Football.* Northumbria University.
3. AKUBAT, I., E. PATEL, S. BARRETT & G. ABT, 2012. Methods of monitoring the training and match load and their relationship to changes in fitness in professional youth soccer players. *Journal of sports sciences.* **30**, 1473‑1480.
4. ALEXANDRE, D., 2008. *From training to performance and soccer*. Paris: legal deposit.
5. ALI, A., 2011. Measuring soccer skill performance: a review. *Scandinavian journal of medicine & science in sports.* **21**, 170‑183.
6. BASSETT, D. R. & E. T. HOWLEY, 2000. Limiting factors for maximum oxygen uptake and determinants of endurance performance. *Medicine and Science in Sports and Exercise.* **32**, 70‑84.
7. BELKADI, A., O . BENBERNOU, M. SEBBANE, A. M. B. H. LAROUA & J. GLEYSE, 2015. Contribution to the Identification of the Professional Skills Profile of Coaches in the Algerian Sport Judo System. *International Journal of Sports Science*. **5,** 145‑150.
8. BOGDANIS, G. C., 2012. Effects of Physical Activity and Inactivity on Muscle Fatigue. *Frontiers in Physiology.* **3.** https://doi.org/10.3389/fphys.2012.00142.
9. CARROLL, J. B., 1993. *Human cognitive abilities: A survey of factor-analytic studies*. Cambridge University Press.
10. CHERARA, L., A. BELKADI, H. ASLI & O. BENBERNOU, 2019. Effects of caloric restriction on anthropometrical and specific performance in highly-trained university judo athletes. *Physical education of students*. **23**, 30‑36.

11. DELP, M. D., R. B. ARMSTRONG, D. A. GODFREY, M. H. LAUGHLIN, C. D. ROSS & M. K. WILKERSON, 2001. Exercise increases blood flow to locomotor, vestibular, cardiorespiratory and visual regions of the brain in miniature swine. *The Journal of Physiology.* **533**, 849‐859.
12. FRANKS, I. M. & D. GOODMAN, 1986. A systematic approach to analysing sports performance. *Journal of Sports Sciences*. **4**, 49‐59.
13. GARGANTA, J., 2009. Trends of tactical performance analysis in team sports: bridging the gap between research, training and competition. *Revista Portuguesa de Ciências do Desporto.* **9,** 81‐89.
14. HALSON, S. L., 2014. Monitoring training load to understand fatigue in athletes. *Sports medicine.* **44**, 139‐147.
15. JANELLE, C. M. & C. H. HILLMAN, 2003. Expert performance in sport. *Expert performance in sports: Advances in research on sport expertise*, 19‐47.
16. JOYNER, M. J. & D. P. CASEY, 2015. Regulation of Increased Blood Flow (Hyperemia) to Muscles During Exercise: A Hierarchy of Competing Physiological Needs. *Physiological Reviews.* **95**, 549‐601.
17. KANG, K. T., R. Z. LIN, D. KUPPERMANN, J. M. MELERO-MARTIN & J. BISCHOFF, 2017. Endothelial colony forming cells and mesenchymal progenitor cells form blood vessels and increase blood flow in ischemic muscle. *Scientific Reports.* **7**. https://doi.org/10.1038/s41598-017-00809-1
18. LOOS, T., G. OPDENAKKER, J. VAN DAMME & P. PROOST, 2009. Citrullination of CXCL8 increases this chemokine's ability to mobilize neutrophils into the blood circulation. *Haematologica.* **94**, 1346‐1353.
19. MAYER, F., F. SCHARHAG-ROSENBERGER, A. CARLSOHN, M. CASSEL, S. MÜLLER & J. SCHARHAG, 2011. The Intensity and Effects of Strength Training in the Elderly. *Deutsches Ärzteblatt International.* **108**, 359‐364.
20. MCBRIDE, J. M., T. TRIPLETT-MCBRIDE, A. DAVIE & R. U. NEWTON, 2002. The effect of heavy- vs. light-load jump squats on the development of strength, power, and speed. *Journal of Strength and Conditioning Research.* **16**, 75‐82.
21. MUWAFAQ MAJEED Al MAWLA, 1999. *Career setting in soccer.* Amman Jordan: Arab Thought House.

22. NYSTORIAK, M. A. & A. BHATNAGAR, 2018. Cardiovascular Effects and Benefits of Exercise. *Frontiers in Cardiovascular Medicine.* **5**. https://doi.org/10.3389/fcvm.2018.00135
23. RUSSO, M. A., D. M. SANTARELLI & D. O'Rourke, 2017. The physiological effects of slow breathing in the healthy human. *Breathe.* **13**, 298‑309.
24. SERRANO, J., S. SHAHIDIAN, J. SAMPAIO & N. LEITE, 2013. The Importance of Sports Performance Factors and Training Contents From the Perspective of Futsal Coaches. *Journal of Human Kinetics.* **38**, 151‑160.
25. SILVA, J. R., G. P. NASSIS & A. REBELO, 2015. Strength training in soccer with a specific focus on highly trained players. *Sports Medicine - Open*, **1.** https://doi.org/10.1186/s40798-015-0006-z
26. SUCHOMEL, T. J., S. NIMPHIUS & M. H. Stone, 2016. The importance of muscular strength in athletic performance. *Sports medicine.* **46**, 1419‑1449.
27. VIGORITO, C. & F. GIALLAURIA, 2014. Effects of exercise on cardiovascular performance in the elderly. *Frontiers in Physiology*. **5**. https://doi.org/10.3389/fphys.2014.00051
28. WORLD MEDICAL ASSOCIATION, 2013. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. *JAMA.* **310**, 2191‑2194.
29. ZATSIORSKY, V. M. & W. J. KRAEMER, 2006. *Science and practice of strength training*. Human Kinetics.
30. ZEMKOVÁ, E. & D. HAMAR, 2018. Sport-Specific Assessment of the Effectiveness of Neuromuscular Training in Young Athletes. *Frontiers in Physiology*. **9.** https://doi.org/10.3389/fphys.2018.00264