STUDIA UBB EDUCATIO ARTIS GYMN., LXII, 4, 2017, pp. 31 - 40
(RECOMMENDED CITATION)
DOI:10.24193/subbeag.62(4).31

STUDY ON THE DEVELOPMENT OF EXPLOSIVE FORCE IN FOOTBALL AT JUNIORS A LEVEL

RAUL NEMEŞ[1], DAN MONEA[1*], RODICA PRODAN[1], CRISTIAN ŞANTA[1]

ABSTRACT. The aim of this paper is to find and implement a program for the development of the muscles of young footballers in order to enforce the transition to seniors and to reduce the physical differences. The research included 40 subjects and faded over a 6 months period. The subjects were selected following the value-based observation, being considered as the most perspective players. The research results confirmed that all 5 follow-up indexes: push-ups, flat bench press, chin-ups, squats, high knee jumps, after the training period showed a good progress. In conclusion, we can once again confirm that the circuit-weight training method is an effective method for developing the force. At the same time, the results of the research show that the age of Juniors "A" (17-18 years) is suitable for the development of force.

Keywords: *force, football, weight training, circuit, juniors*.

REZUMAT. Studiul dezvoltării forţei explozive în fotbal la juniori. Forţa fizică depinde de activitatea sistemului nervos central, de secţiunea fiziologică a muşchiului şi de procesele biochimice care au loc în muşchi. Eforturile voinţei, concentrării şi atenţiei pe care este capabil atletul sunt de asemenea foarte importante. Din punct de vedere biochimic, forţa contracţiei musculare depinde de natura impulsurilor nervoase, modul de transmitere a acestor impulsuri şi de acţiunea ATP asupra miozinei musculare. Scopul acestei lucrări este de a găsi şi implementa un program de dezvoltare a sistemului muscular a tinerilor fotbalişti pentru a impune trecerea spre performanţă şi a reduce diferenţele fizice. Cercetarea a inclus 40 de subiecţi pe o perioadă de 6 luni. Subiecţii au fost selectaţi în urma observării valorice, fiind consideraţi cei mai de perspectivă jucători. Rezultatele cercetării au confirmat faptul că toţi cei 5 indicatori de urmărire: ridicări din culcat facial, împins din culcat dorsal pe plan orizontal, tracţiuni bara fixa, genuflexiune, sărituri cu genunchi sus, după perioada de antrenament au înregistrat un progres bun. În concluzie, putem confirma încă o

[1] Babeş-Bolyai University, Cluj-Napoca, Romania
** Corresponding Author: moneadan@yahoo.com*

dată că metoda de antrenament cu greutăţi în circuit, este o metodă eficientă pentru dezvoltarea forţei. În acelaşi timp, rezultatele cercetărilor arată că vârsta juniori "A" (17-18 ani) este potrivită pentru dezvoltarea forţei.

Cuvinte cheie: *forţă, fotbal, pregătire în greutate, circuit, juniori*

Introduction

Physical strength depends on the activity of the central nervous system, the physiological section of the muscle, the biochemical processes taking place in the muscles, as well on the efforts of the will, concentration and attention that the athlete is capable of. From the biochemical point of view, the force of muscle contraction depends on the nature of the nerve impulses, the way of transmitting these impulses, and the action of ATP on muscle myosin.

The muscular hypertrophy that emerges from strength training is because of from the high protein consumption that takes place in such endeavors (Florescu, 1975).

For the education of force, it is necessary to take into account the following aspects:

- Simultaneous mobilization of the maximum number of functional units,
- Maximizing the effort of will and attention focus on the work being done,
- Increasing the physiological section of the muscles.

In terms of muscle strength, the conditioning reaction is known to be very variable.

As a result of the training, the isolated subject can record evolutions, stagnation or even involution of the muscular force. But, if group training is more frequent (as number of weekly sessions), it is possible that the strength of more subjects will evolve.

The results from the study made by Wisloff et al (2004) indicated that there was no relation between the 10 m shuttle run and the 30 m sprint test. However, after Cormie et al (2011) and Silva et al (2015) both sprint capacities are of importance in soccer, and the obtained data show that both capacities should be included and evaluated in a sprint test battery of soccer players.

The results obtained by Maio Alvez et al (2010) suggested that the complex and contrast training (CCT) induced the performance increase in 5 and 15 m sprint and in squat jump. Vertical jump and sprint performances after CCT program were not influenced by the number of CCT sessions per week (1 or 2 sessions/wk). From the obtained results, it was suggested that the CCT is an adequate training strategy to develop soccer players' muscle power and speed.

Sedano et al (2011) studied the effects of plyometric training on explosive strength, acceleration capacity and kicking speed in young elite soccer players, after Paavolainen et al (1999) and Lopez-Segovia et al (2010). Marques et al (2013), Saez de Villareal et al (2013) and Chtara et al (2017) confirmed that the replacement of some soccer-specific training with plyometric, agility, or repeated shuttle sprint exercises would enhance explosive actions, agility and anaerobic performance to a greater extent in young soccer players than soccer training alone.

After Jovanovic et al (2011), their proposed speed, agility, quickness training program appears to be an effective way of improving some segments of power performance in young soccer players during the in-season period. After Keiner et al (2014) football coaches could use this information in the process of planning in-season training. Without proper planning of the SAQ training, soccer players will most likely be confronted with decrease in power performance during in-season period.

Cicioni-Kolsky et al (2011) examined the effect of two different interval training programs–high-intensity interval training (HIT) and supramaximal interval training (SMIT)–on measures of sprint and endurance performance. The study showed that for concurrent improvements in endurance, sprint and repeated sprint performance, SMIT provides the greatest benefits for physically active individuals.

Wahl et al (2014) revealed that 4 weeks without high intensity training (HIT) had moderate to large decreasing effects on physical performance. On the contrary, 2-week HIT shock microcycle is a promising tool in preseason training of semi-professional soccer players to largely improve Repeated-Sprint-Ability $(RSA)_{Index}$ by 46% (Cohen's d = -1.99), RSA_{Mean} by 2.3% (Cohen's d = -1.15) and Yo-Yo Intermittent Recovery Test Level 2 (YYIR2) performance by 24% (Cohen's d = +1.92) of semi-professional soccer players. These results were further confirmed by Keiner et al (2014).

Balsalobre-Fernández et al (2015) observed after Tonnessen et al (2013) that a month of active rest during the off-season break is enough to prevent decreases in force production of such athletes.

The effectiveness of the different techniques implies reaching the limit force by the subjects, which allows an accurate determination of the role played by the candidates' prior training and attenuates any reaction depending on their initial strength. A shorter number of weeks to reach the limit force indicate the superiority of a technique. This is true only when all subjects have a relative equal initial force, and all practice the same training method.

Behm et al (2017) proved that power training was more effective than strength training for improving youth jump height. For sprint measures, strength training was more effective than power training with youth. Furthermore, strength training exhibited consistently large magnitude changes to lower body strength measures, which contrasted with the generally trivial, small and moderate magnitude training improvements of power training upon lower body strength, sprint and jump measures, respectively.

Abade et al (2017) in their research explored the effects of the re-warm-up performed in the time gap between the end of the warm-up and the beginning of the match. It was proved that re-warm-up exercises such as plyometrics and repeated changes of direction are simple, quick and efficient activities to attenuate losses in power output during vertical jump and sprint activities after warm-up.

Helgerud et al (2011) observed that their concurrent strength and endurance training program together with regular football training resulted in considerable improvement of the players' physical capacity and so may be successfully introduced to elite football players. Moreover, after Di Giminiani &Visca (2017) the tests used in the study are practical and reliable predictors to monitor explosive strength, and endurance performance changes in young elite soccer players. Secondly, the training structure and the improvements evidenced provide helpful guidelines of expected longitudinal gains in endurance and strength performance of elite soccer players from 13 to 15 years.

The qualitative aspect of the accumulations can be analyzed from two points of view: the "angular" specificity and the "working" specificity.

The "angular" specificity is the most important increase in muscle strength. For example, following an isotonic training with maximum resistance, knee extensions register a more significant increase in force at an angle of 115°. In isometric training, strength development appears to be less specific. It is noted the existence of a certain specificity for one or two muscle groups trained at different angles.

Specificity of "work": In subjects trained with concentric isotonic contractions, the evolution of isometric force is not proportional to the isotonic force. The percentage increase in isotonic force exceeds the percentage increase of isometric values. It is concluded that an eccentric isotonic contraction implies a more spectacular evolution than the concentric isotonic contraction.

The assumptions of the research

In the course of the experiment, the established hypothesis was that the circuit method can make the physical training of athletes more efficient, especially the force in speed mode.

Theoretical data of the experiment

The design of the research

This research is quasi-experimental; the 40 subjects born in 2000 were selected based upon the observation method. In co-operation with the coach of A.C.S Sporting Cluj U18 team, Alin Bărăian, the selected subjects were considered to have perspective in the football performance but at this stage have some deficiencies in terms of force quality in speed.

Strength training sessions were flown three times a week in the morning at 6:45 am and lasted for 45 minutes.

Subjects

The subjects included in this study are members of the A.C.S. Sporting Cluj football team and they play at Junior A1 level. The anthropometric measurements were as follows: height 1.66 – 1.83 m; weight 60 – 72 kg.

Time and place of the research

The research was conducted at the Big Fitness Hall during the period 01.02.2017 - 31.07.2017.

The research period was divided into 3 stages as follows:

- 1st of February 2017 – Initial test,
- 2nd of February - 30th of July 2017 – experimental training period,
- 31th of July 2017 – Final test.

For the development of force, the 9-point circuit training method was used, each station having a different load depending on the body mass of the subject. Each training was structured in three to five parts:

- Preparing the body for effort and the selective influence of the locomotive apparatus (12 minutes)
- Circuit 1 (9 minutes)
- Rest (4 minutes)
- Circuit 2 (9 minutes)
- Rest and stretching (10 minutes).

Table 1. The circuit components

Exercise	Series	Dosage	Charge
Leg press	2	25-20, 20-15 rep.	100% From the body mass of the subject.
Machine bench press	2	25-20, 20-15 rep.	50% From the body mass of the subject.
Seated cable row or pulldown to front	2	25-20, 20-15 rep.	25% From the body mass of the subject.
Machine shoulder press	2	25-20, 20-15 rep.	20% From the body mass of the subject.
Calves extension	2	25-20, 20-15 rep.	25% From the body mass of the subject.
Leg flexures	2	25-20, 20-15 rep.	75% From the body mass of the subject.
Biceps flexures – machine	2	25-20, 20-15 rep.	25% From the body mass of the subject.
Triceps press – machine	2	25-20, 20-15 rep.	25% From the body mass of the subject.
Crunch - machine	2	25-20, 20-15 rep.	50% From the body mass of the subject.

At each station the actual working time was 40 seconds followed by a pause of 20 seconds, during which the subjects changed the workstation. The break between the two circuits was 4 minutes.

Results

Initial Test

Table 2. Initial test sample values

No.	Push-ups	Flat bench press / min	Chin – ups / min	Squats / min	High knee jumps / min
1	27	13	7	27	42
2	22	15	9	20	47
3	33	18	6	32	53
4	35	16	10	34	55
Average	29.25	15.5	8	28.25	49.25

Final test

Table 3. Final test sample values

No.	Push-ups	Flat bench press / min	Chin – ups / min	Squats / min	High knee jumps / min
1	39	27	15	42	68
2	33	20	13	36	59
3	35	25	12	39	65
4	37	23	14	40	55
Average:	36	23.75	13.5	39.25	61.75

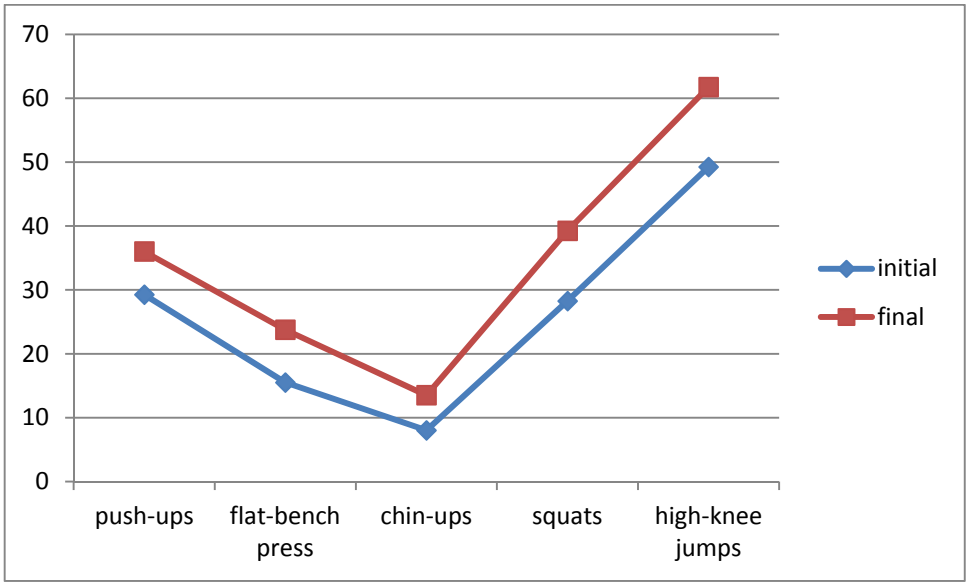

Figure 1. Evolution of average values from the initial to the final test

Comparing the obtained results with those of Saez de Villarreal et al. (2013) showed that advanced training associated with neural and morphological adaptations allow a better optimal power development and transfer to athletic activities.

When comparing them with those from the research of Wisloff et al (2004), the sole performance of one type of plyometric exercise, which has an apparent lower level of specificity, may explain, at least in part, the lack of transfer of training

adaptations to dynamic and complex activities, where the coordination and force production of different body muscles, as is the case of sprint performance, are essential.

Analyzing the results and comparing them with those of Balsalobre-Fernández et al, (2015) and Behm et al, (2017), it seems that strength/power training induces greater improvements in jump abilities than in running-based activities. Moreover, combining resistance- and speed-training or plyometric- and football-specific strength programs in the same session seems to be more effective than the resistance-training program alone

The multi-factorial constructs of football performance (technical, tactical, and physical performance) and their associated components bring a higher complexity to the designing of the training process, as was observed by Wahl et al, (2014). Moreover, professionals involved in the preparation of football teams have to reflect on some questions associated with the manipulation of the individual variables that affect each of these relevant constructs and how they can affect each other.

Conclusions

All research data has led to the confirmation of the hypothesis according to which the method of the circuit can physiologically improve the physical training of the athletes, especially the force in speed mode.

The means and methods used in the research found an improvement in the development of force.

The obtained results lead to the conclusion that force at this age can be influenced.

The development of force by our means does not harm the physical training as a whole, but on the contrary, these means form skills that can help in the future, acquiring more complex motor actions.

REFERENCES

Abade E, Sampaio J, Gonçalves B, Baptista J, Alves A, Viana J. (2017). *Effects of different re-warm up activities in football players' performance*. Ardigò LP, ed. PLoS ONE;12(6):e0180152. doi:10.1371/journal.pone.0180152.

Balsalobre-Fernández C, Tejero-González CM, del Campo-Vecino J. (2015). Seasonal Strength Performance and Its Relationship with Training Load on Elite Runners. *Journal of Sports Science & Medicine*;14(1):9-15.

Behm DG, Young JD, Whitten JHD, et al. (2017). Effectiveness of Traditional Strength vs. Power Training on Muscle Strength, Power and Speed with Youth: A Systematic Review and Meta-Analysis. *Frontiers in Physiology*; 8:423. doi:10.3389/ fphys.2017.00423.

Chtara M, Rouissi M, Haddad M, et al. (2017). Specific physical trainability in elite young soccer players: efficiency over 6 weeks' in-season training. *Biology of Sport*. 2017;34(2):137-148. doi:10.5114/biolsport, 64587.

Cicioni-Kolsky D, Lorenzen C, Williams MD, Kemp JG. (2013). Endurance and sprint benefits of high-intensity and supramaximal interval training. *Eur J Sport Sci*.;13(3):304–11. doi: 10.1080/17461391.2011.606844

Cormie P, McGuigan MR, Newton RU. (2011). Developing maximal neuromuscular power: Part 1–biological basis of maximal power production. *Sports Med*.;41(1):17–38. doi: 10.2165/11537690-000000000-00000

Di Giminiani R, Visca C. (2017). Explosive strength and endurance adaptations in young elite soccer players during two soccer seasons. *Philp A, ed. PLoS ONE*.; 12(2):e0171734. doi:10.1371/journal.pone.0171734.

Helgerud J, Rodas G, Kemi OJ, Hoff J. (2011). Strength and endurance in elite football players. *Int J Sports Med.;*32(9):677–82. doi: 10.1055/s-0031-1275742

Jovanovic M, Sporis G, Omrcen D, Fiorentini F. (2011). Effects of speed, agility, quickness training method on power performance in elite soccer players. *J. Strength Cond. Res*.;25(5):1285–92. doi: 10.1519/JSC.0b013e3181d67c65

Keiner M, Sander A, Wirth K, Schmidtbleicher D. (2014). Long-term strength training effects on change-of-direction sprint performance. *J Strength Cond Res*.;28(1):223–31. doi: 10.1519/JSC.0b013e318295644b

Lopez-Segovia M, Palao Andres JM, Gonzalez-Badillo JJ. (2010). Effect of 4 months of training on aerobic power, strength, and acceleration in two under-19 soccer teams. *J. Strength Cond. Res.*;24(10):2705–14.
doi: 10.1519/JSC.0b013e3181cc237d

Maio Alves JM, Rebelo AN, Abrantes C, Sampaio J. (2010). Short-term effects of complex and contrast training in soccer players' vertical jump, sprint, and agility abilities. *J. Strength Cond. Res*.;24(4):936–41.
doi: 10.1519/JSC.0b013e3181c7c5fd

Marques MC, Pereira A, Reis IG, van den Tillaar R. (2013). Does an in-Season 6-Week Combined Sprint and Jump Training Program Improve Strength-Speed Abilities and Kicking Performance in Young Soccer Players? *Journal of Human Kinetics*.;39:157-166. doi:10.2478/hukin-2013-0078.

Paavolainen L, Hakkinen K, Hamalainen I, Nummela A, Rusko H. (1999). Explosive-strength training improves 5-km running time by improving running economy and muscle power. *J Appl Physiol*.;86(5):1527–33

Rodríguez-Lorenzo L, Fernandez-del-Olmo M, Sanchez-Molina JA, Martín-Acero R. (2016). Role of Vertical Jumps and Anthropometric Variables in Maximal Kicking Ball Velocities in Elite Soccer Players. *Journal of Human Kinetics*; 53:143-154. doi:10.1515/hukin-2016-0018.

Saez de Villarreal E, Requena B, Izquierdo M, Gonzalez-Badillo JJ. (2013). Enhancing sprint and strength performance: combined versus maximal power, traditional heavy-resistance and plyometric training. *J Sci Med*.; 16(2):146–50

Sedano S, Matheu A, Redondo JC, Cuadrado G. (2011). Effects of plyometric training on explosive strength, acceleration capacity and kicking speed in young elite soccer players. *J Sports Med Phys Fitness*.; 51(1):50–8

Silva JR, Nassis GP, Rebelo A. (2015). Strength training in soccer with a specific focus on highly trained players. *Sports Medicine - Open*; 1:17. doi:10.1186/s40798-015-0006-z

Tonnessen E, Hem E, Leirstein S, Haugen T, Seiler S.(2013). Maximal aerobic power characteristics of male professional soccer players, 1989-2012. *Int J Sports Physiol Perform*.;8(3):323–9

Wahl P, Guldner M, Mester J. (2014). Effects and sustainability of a 13-day high-intensity shock microcycle in soccer. *J Sports Sci Med*.;13(2):259–65

Wisloff U, Castagna C, Helgerud J, Jones R, Hoff J. (2004). Strong correlation of maximal squat strength with sprint performance and vertical jump height in elite soccer players. *British Journal of Sports Medicine*; 38(3):285-288. doi:10.1136/bjsm.2002.002071