INFLUENCE OF STRENGTH TRAINING ON THE EXPLOSIVE POWER OF LOWER LIMBS OF SOCCER PLAYERS

INFLUÊNCIA DO TREINAMENTO DE FORÇA NA POTÊNCIA EXPLOSIVA DOS MEMBROS INFERIORES DOS JOGADORES DE FUTEBOL

INFLUENCIA DEL ENTRENAMIENTO DE FUERZA EN LA POTENCIA EXPLOSIVA DE LOS MIEMBROS INFERIORES DE LOS FUTBOLISTAS

Original Article
Artigo Original
Artículo Original

Dong Zhang[1]
(Physical Education Professional)
Jie Yu[1]
(Physical Education Professional)

1. Jimei University, College of Physical Education, Xiamen, Fujian, China.

Correspondence:
Jie Yu
Xiamen, 361000, Fujian, China.
361000. 66218168@qq.com

ABSTRACT

Introduction: The explosive power of the lower limbs is an indispensable index in soccer. Having a good level of explosive power establishes a solid foundation for the performance and the competitive level of soccer players. Objective: Promote the conditions to improve the explosive level of soccer players and improve their performance and competitive level. Methods: This paper presents the influence of compound strength training on the explosive power of the lower limbs of soccer athletes. Based on 27 young 9-year-old soccer players from Zai Ming Football Club of a sports college as experimental material, the composite training was carried out. Results: The growth rates of these rates in the experimental group were 3.3%, 2.3%, 5.0%, 3.6%, 9.2%, 12.1%, 20.5%, 5.7%, 11.9%, 16.9% and 19.5% respectively, while those in the control group were 1.2%, 0.7%, 4.2%, 3.1%, 6.8%, 7.8%, 5.1%, 4.2%, 4.8%, 12.5% and 19.2% respectively. The growth rate of the experimental group was higher than that of the control group and the blank control group. Conclusion: Compared with the control group and the neutral control group, the experimental group with compound training has a better training effect on improving the lower limb explosiveness of youth soccer players. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Soccer; Physical Education and Training; Lower Limbs.

RESUMO

Introdução: A potência explosiva dos membros inferiores é um índice indispensável no futebol. Ter um bom nível de potência explosiva estabelece uma base sólida para o desempenho e o nível competitivo dos futebolistas. Objetivo: Promover as condições para melhorar o nível explosivo dos jogadores de futebol e aperfeiçoar seu desempenho e nível competitivo. Métodos: Este documento apresenta a influência do treinamento de força composta no poder explosivo dos membros inferiores dos atletas de futebol. Com base em 27 jovens jogadores de futebol com 9 anos de idade do Zai Ming Football Club de uma faculdade esportiva como material experimental, foi realizado o treinamento composto. Resultados: As taxas de crescimento destes índices no grupo experimental foram de 3,3%, 2,3%, 5,0%, 3,6%, 9,2%, 12,1%, 20,5%, 5,7%, 11,9%, 16,9% e 19,5% respectivamente, enquanto os do grupo de controle foram de 1,2%, 0,7%, 4,2%, 3,1%, 6,8%, 7,8%, 5,1%, 4,2%, 4,8%, 12,5% e 19,2% respectivamente. A taxa de crescimento do grupo experimental foi maior do que a do grupo de controle e do grupo de controle em branco. Conclusão: Em comparação com o grupo de controle e o grupo de controle neutro, o grupo experimental com treinamento composto tem um melhor efeito de treinamento para melhorar a explosividade dos membros inferiores dos jogadores de futebol juvenil. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Futebol; Educação Física e Treinamento; Membros Inferiores.*

RESUMEN

Introducción: La potencia explosiva de los miembros inferiores es un índice indispensable en el fútbol. Tener un buen nivel de potencia explosiva establece una base sólida para el rendimiento y el nivel competitivo de los futbolistas. Objetivo: Promover las condiciones para mejorar el nivel explosivo de los futbolistas y mejorar su rendimiento y nivel competitivo. Métodos: Este trabajo presenta la influencia del entrenamiento de fuerza compuesta en la potencia explosiva de los miembros inferiores de los atletas de fútbol. Se llevó a cabo el entrenamiento compuesto con 27 jóvenes jugadores de fútbol de 9 años del Club de Fútbol Zai Ming de una escuela deportiva como material experimental. Resultados: Las tasas de crecimiento de estos índices en el grupo experimental fueron del 3,3%, 2,3%, 5,0%, 3,6%, 9,2%, 12,1%, 20,5%, 5,7%, 11,9%, 16,9% y 19,5% respectivamente, mientras que las del grupo de control fueron del 1,2%, 0,7%, 4,2%, 3,1%, 6,8%, 7,8%, 5,1%, 4,2%, 4,8%, 12,5% y 19,2% respectivamente. La tasa de crecimiento del grupo experimental fue mayor que la del grupo de control y del grupo de control en blanco. Conclusión: En comparación con el grupo de control y el grupo de control neutro, el grupo experimental con entrenamiento compuesto tiene un mejor efecto de entrenamiento para mejorar la explosividad de las extremidades inferiores de los futbolistas juveniles. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Fútbol; Educación y Entrenamiento Físico; Miembros Inferiores.*

DOI: http://dx.doi.org/10.1590/1517-8692202329012022_0280 Article received on 06/04/2022 accepted on 07/15/2022

INTRODUCTION

With the continuous development of football, the pace of football matches is getting faster and faster, which requires the improvement of players' competitive ability, and correspondingly requires players to have a better physical level.[1] The density of football players is very high, and the physical condition of players in the game directly affects the exertion of technical and tactical level. At present, compared with the youth training in western developed countries, the competitive ability of Chinese youth football players is very low, the technical and tactical aspects need to be improved, and the physical level also needs to be improved. How to improve the physical fitness of youth players is a focus and hot issue in today's football industry. Hammer s m and others believe that the instep front kick is suitable for long-distance service and strong shooting. It not only needs strong leg strength as the support condition, but also needs strong explosive force to improve the initial speed of the ball.[2] Singh J and others believe that core strength is conducive to providing a solid fulcrum for limb movement and building a complete special sports chain, which plays a vital role in the balance ability of the body. The stronger the core muscle group, the better the explosive power and sensitivity of athletes' lower limbs.[3] Bailey J and others believe that compound training should be a combination of strength, jumping and speed strength training.[4]

METHOD

Research object

Taking 27 young football players aged 9 years of Zai Ming Football Club of a sports college as the experimental object, they all have training experience of 2 years or more. Divided into experimental group: compound training group, strength training + rapid telescopic compound training, n = 9, control group: traditional strength training group, n = 9, blank control group: no training intervention, n = 9. The reason for setting up the blank control group is that teenagers, a special population, are in a sensitive period, accompanied by changes in growth and development. At the same time, they also have their own special football courses in addition to intervention training.[5]

Experimental method

After clarifying the experimental scheme, select appropriate subjects according to the experimental conditions for the experimental test, collect the relevant data required by the subjects and the test before the experiment, and then conduct group intervention for a certain time. After the intervention experiment, collect the data of the test items at the end of the experiment, and draw the experimental conclusion through the data comparison before and after the experiment.[6]

All data were tested by Shapiro Wilk for normal distribution, and the experimental results were expressed in the form of mean 1 standard deviation ($x \pm SD$). At the same time, the comparative analysis of intra group data and inter group data was analyzed by paired sample t-test and one-way ANOVA. The statistically significant difference was expressed as $P < 0.05$ and the extremely significant difference was expressed as $P < 0.01$.[7]

Index selection of compound training program

Index selection of compound training program: height and weight; 30 meter sprint; Standing long jump; In situ vertical jump and touch high; 5×15 meter turn back run; 10 yard sprint; T test; CMJ pinches his feet and jumps backwards;

RESULTS AND ANALYSIS

Comparative analysis of the lower limb explosive power of the three groups of athletes after the experiment

Comparative analysis of site test indexes between groups

From the analysis in Table 1, firstly, the difference between the experimental group and the control group after the experiment is only significant in t-test, and the other indexes do not show significant differences; Secondly, compared with the blank control group, the experimental group showed extremely significant differences in 30 meter sprint, standing long jump, in-situ vertical jump and touch height, 5×15 meter turn back run, 10 yard sprint and t-test. Finally, compared with the blank control group, the control group showed significant differences in indicators such as 30m sprint, standing long jump and 5×15m turn back run, extremely significant differences in 10 yard sprint and t-test, and no significant differences in other indicators.[8,9]

Comparative analysis of indexes of three-dimensional dynamometer.

According to the analysis in Table 2, there is no significant difference in the indexes of three-dimensional dynamometer between the experimental group and the control group, and between the control group and the blank control group; In the comparison between the experimental group and the blank control group, only the reverse jump height showed significant differences, and the other indicators showed significant differences.

Overall analysis of lower limb explosive force of athletes in the third group

After the experiment, the statistical method of one-way ANOVA was also used to statistically analyze the lower limb explosive force index and three-dimensional dynamometer index of the three groups. The analysis results are shown in Table 3.

Table 1. Comparison and analysis between site test index groups.

	P value		
	Experiment - Control	Experiment - Blank	Control - Blank
30 meter sprint	0.492	0.005	0.026
Standing long jump	0.624	0.018	0.052
Vertical jump in place	0.107	0.019	0.393
5×15 meter turn back run	0.857	0.001	0.029
10 yard sprint	0.107	0.001	0
T test	0.035	0	0

Table 2. Comparison and analysis between three-dimensional dynamometer index groups.

	P value		
	Experiment - Control	Experiment - Blank	Control - Blank
Reverse jump height	0.085	0.020	0.503
Relative peak force	0.444	0.251	0.693
Relative peak power	0.522	0.334	0.115
Time to reach the maximum ground reaction force	0.237	0.199	0.916
Force rate	0.382	0.130	0.505

Table 3. Comparative Analysis of site test indexes of the three groups after the experiment.

Group	30 meter sprint	Standing long jump	Vertical jump in place	5×15 meter turn back run	10 yard sprint	T test
Experience group	5.51±0.41	164.55±11.24	38.72±5.8	16.89±1.01	2.16±0.09	11.85±0.88
Control group	5.63±0.19	161.43±9.45	36.95±4.79	16.8±0.83	2.18±0.03	12.49±0.47
Blank Control group	6.08±0.49	1148.24±18.34	32.92±3.97	17.47±1.05	2.34±0.13	14.21±0.73
P value	0.015	0.046	0.057	0.001	0	0

It can be seen from Table 3 that after the experiment, the field test indexes of the three groups were compared and analyzed. They showed significant differences in the two indexes of 30m sprint, standing long jump, 5×15m turn back run, 10 yard sprint and t test ($P < 0.05$), and extremely significant differences in the indexes of 5×15m turn back run, 10 yard sprint and t test ($P < 0.01$).

According to the above summary: after eight weeks of experimental intervention, the explosive power of the subjects' lower limbs was significantly improved. According to the characteristics of the football project, the strength and rapid telescopic compound training actions similar to the special actions and force generating parts are selected. The experimental group shows significant differences in the indexes of 30 meter sprint, in-situ vertical jump and touch height, 5×15 meter turn back run, 10 yard sprint and t-test. Among the indexes measured by the force measuring platform, the reverse jump height, relative peak power and force generating rate also show significant differences. At the same time, there were extremely significant differences in 5×15 meter turn back run, 10 yard sprint and t test, while there were only extremely significant differences in 10 yard sprint and t test in the control group, and there were no significant changes in other indexes of the control group and the blank control group.

This paper analyzes the index of in-situ vertical jump and touch height. Firstly, the compound training adopted by the experimental group can activate the body through the traditional strength training, and then carry out the rapid expansion and contraction compound training to do the muscle lengthening and shortening exercise. The training means adopted is also the rapid strength and explosive force training for the muscle lengthening and contraction exercise. Therefore, the experimental group showed significant differences in the index of in-situ vertical jump and touch height, indicating that compound training is conducive to improving the level of in-situ vertical jump and touch height.[10]

Overall situation analysis of three-dimensional dynamometer index.

It can be seen from Figure 1 that after the experiment, the indexes of three-dimensional force measuring platform of the three groups were compared and analyzed, and they showed significant differences in relative peak force indexes ($P < 0.05$), but there were no significant differences in reverse jump height, relative peak power, time to reach the maximum ground reaction force and force rate. However, in general, the growth rates of these indexes in the experimental group were 3.3%, 2.3%, 5.0%, 3.6%, 9.2%, 12.1%, 20.5%, 5.7%, 11.9%, 16.9% and 19.5% respectively, while those in the control group were 1.2%, 0.7%, 4.2%, 3.1%, 6.8%, 7.8%, 5.1%, 4.2%, 4.8%, 12.5% and 19.2% respectively. The growth rate of the experimental group is higher than that of the control group and the blank control group, which is enough to see that the experimental group with compound training has a better training effect in improving the lower limb explosiveness of juvenile football players compared with the control group and the blank control group. Therefore, in the follow-up related training, this method of compound training can be introduced into the youth football training course to provide guiding help for their future training practice.

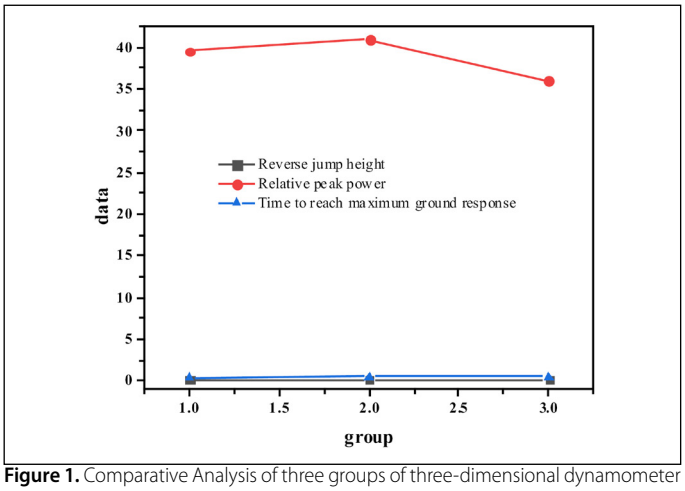

Figure 1. Comparative Analysis of three groups of three-dimensional dynamometer indexes after the experiment.

CONCLUSION

The indexes of the three-dimensional force measuring platform in this study include reverse jump height, relative peak force, relative peak power, time to reach the maximum ground reaction force and force rate. There was no significant difference in the two indexes of relative peak force and the time to reach the maximum ground reaction force, but there were significant differences in reverse jump height, relative peak power and force rate. The reflection of the height index of reverse jump is mainly presented by pinching the waist with both feet. The completion of the action comes from the stretching and shortening movement completed by the extensor muscles of the lower limbs. The centrifugal contraction occurs through the passive stretching reaction, and then quickly transforms into centripetal contraction. In the stage of knee bending and squatting, the length of gluteus maximus, quadriceps femoris and triceps crus is lengthened, and the hands are on the hips, reducing the effect of external force exerted by the swing arm on the completion of the action. The increase of reverse jump height will also have a positive impact on the peak power and force rate. Therefore, the experimental group has significant differences in these three indicators, while there is no significant difference between the control group and the blank control group.

All authors declare no potential conflict of interest related to this article

AUTHORS' CONTRIBUTIONS: Each author made significant individual contributions to this paper. JY: study conception and design; write the paper; performed the analysis; DZ: data collection; article review.

REFERENCES

1. Nobari H, Alves AR, Clemente FM, Pérez-Gómez J. Influence of 2D:4D ratio on fitness parameters and accumulated training load in elite youth soccer players. BMC Sports Sci Med Rehabil. 2021;13(1):1-12.
2. Hammer SM, Hammond ST, Parr SK, Alexander AM, Turpin VRG, White ZJ, et al. Influence of muscular contraction on vascular conductance during exercise above versus below critical power. Respir Physiol Neurobiol. 2021;293(1985):103718.
3. Singh JJ, Mehta JS, Kumar R, Sapra G. FEA simulations of Lower Limb Prosthetics. IOP Conference Series: Materials Science and Engineering. 2022;1225(1):012030.
4. Bailey J, Irving R, Dawson P, Brown DR, Campbell E. Influence of Training-induced Testosterone and Cortisol Changes on Skeletal Muscle and Performance in Elite Junior Athletes. Am J Sports Sci Med. 2021;9(1):13-23.
5. Kumar SK, Perumal S, Subramani A. Influence of Zercher Squat Exercises on Back Strength and Leg Strength among College Basketball Players. J Inf Comput Sci. 2020;10(2):45-50.
6. Praça G, Barbosa GF, Murta CSCF, Bredt S, Barreira D, Chagas MH, et al. Influence of floaters and positional status on players' tactical, physical, and physiological responses in soccer small-sided games. Hum Mov. 2020;20(3):54-63.
7. Izquierdo JM, AMD Benito, Araiz G, Guevara G, Redondo JC. Influence of competition on performance factors in under-19 soccer players at national league level. PLoS ONE. 2020;15(3):e0230068.
8. Lv X, He Y, Sun D, Baker JS, Xuan R, Gu Y. Effect of stud shape on lower limb kinetics during football-related movements. J Sports Eng Technol. 2020;234(1):3-10.
9. Mel'Nikov AA, Smirnova PA, Nikolaev RY, Podolyaka OB, Andreeva AM. Influence of Stretching Training of the Lower Limbs on Postural Stability. Hum Physiol. 2021;47(3):270-81.
10. Zhang Y, Sun B. Influence of Sports Games on Children's Coordination Ability and Lower Limb Muscle Strength: 2145 Board #64 May 28 2:00 PM - 3:30 PM. MSSE. 2020;52(Suppl 7):569-70.