ABDOMINAL CORE MUSCLE STRENGTH TRAINING IN WEIGHTLIFTERS

TREINAMENTO DE FORÇA DO CENTRO ABDOMINAL EM HALTEROFILISTAS

ENTRENAMIENTO DE FUERZA DEL NÚCLEO ABDOMINAL EN LEVANTADORES DE PESAS

ORIGINAL ARTICLE
ARTIGO ORIGINAL
ARTÍCULO ORIGINAL

Wenjun Bi[1]
(Physical Education Professional)
Yunna Zhao[1]
(Physical Education Professional)
Hui Zhao[1]
(Physical Education Professional)

1. Hebei Construction Material Vocational and Technical College, Qinhuangdao, Hebei, China.

Correspondence:
Yunna Zhao
Qinhuangdao, Hebei, China, 066004.
gaozhigongjiang@163.com

ABSTRACT

Introduction: Lifting weights requires muscular capacity, strength, and determination. Strength training for weightlifters stimulates the nervous system and promotes muscle hypertrophy. Strength training is the most important point in weightlifters' training. Objective: Explore the effects of abdominal core strength training on the physical fitness of weightlifters. Methods: 26 weightlifters were selected by random sampling. The athletes participated in physical training for 26 weeks. Athletes' physical fitness was measured before and after training. Tests included the y-Balance test, stability exercises, and abdominal center strength. After each training session, the players used foam rollers and baseballs for recovery training. After the experiment was completed, the data was analyzed by mathematical statistics. Results: The left lower limb stability of the weightlifters was better than the right in the Ans direction; in all three directions, there were extremely significant ipsilateral differences before and after the experiment($P<0.05$). There was a highly significant difference between the level and super level of the ipsilateral upper limbs of the athletes ($P<0.05$). Conclusion: Weightlifters who practiced abdominal core strength exercises significantly improved the dynamic stability of the lower limbs. Young male weightlifters' upper limb motion stability is more symmetrical during abdominal core strength exercises. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: *Abdominal Core; Muscle Strength; Physical Fitness; Weight Lifting.*

RESUMO

Introdução: A elevação de pesos exige capacidade muscular, força e determinação. O treinamento de força para halterofilistas estimula o sistema nervoso e promove a hipertrofia muscular. Sendo o treinamento de força é o ponto mais importante no treino dos halterofilistas. Objetivo: Explorar os efeitos do treinamento de força do centro abdominal sobre a aptidão física dos halterofilistas. Métodos: 26 halterofilistas foram selecionados por amostragem aleatória. Os atletas participaram do treinamento físico durante 26 semanas. A aptidão física dos atletas foi medida antes e depois do treinamento. Entre os testes estão o teste y-Balance, exercícios de estabilidade e força do centro abdominal. Após cada treinamento, os jogadores utilizaram rolos de espuma e bolas de beisebol para o treinamento de recuperação. Após a conclusão do experimento, os dados foram analisados por estatísticas matemáticas. Resultados: A estabilidade do membro inferior esquerdo dos halterofilistas foi melhor do que o direito na direção Ans; nas três direções, houveram diferenças ipsilaterais extremamente significativas antes e depois do experimento($P<0,05$). Houve uma diferença muito significativa entre o nível e o super nível dos membros superiores do ipsilateral dos atletas ($P<0,05$). Conclusão: Halterofilistas que praticaram exercícios de força do centro abdominal melhoraram significativamente a estabilidade dinâmica dos membros inferiores. A estabilidade do movimento dos membros superiores dos jovens halterofilistas masculinos é mais simétrica durante o exercício de força do centro abdominal. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Centro Abdominal; Força Muscular; Aptidão Física; Levantamento de Peso.*

RESUMEN

Introducción: La halterofilia requiere capacidad muscular, fuerza y determinación. El entrenamiento de fuerza para levantadores de pesas estimula el sistema nervioso y promueve la hipertrofia muscular. El entrenamiento de fuerza es el punto más importante en el entrenamiento de los levantadores de pesas. Objetivo: Explorar los efectos del entrenamiento de fuerza en el núcleo abdominal sobre la aptitud física de los levantadores de pesas. Métodos: Se seleccionaron 26 levantadores de pesas por muestreo aleatorio. Los atletas participaron en el entrenamiento físico durante 26 semanas. Se midió la aptitud física de los atletas antes y después del entrenamiento. Las pruebas incluían el test y-Balance y, ejercicios de estabilidad y fuerza del núcleo abdominal. Después de cada sesión de entrenamiento, los jugadores utilizaron rodillos de espuma y pelotas de béisbol para el entrenamiento de recuperación. Una vez finalizado el experimento, los datos se analizaron mediante estadística matemática. Resultados: La estabilidad de la extremidad inferior izquierda de los levantadores de pesas fue mejor que la derecha en la dirección Ans; en las tres direcciones, hubo diferencias ipsilaterales extremadamente significativas antes y después del experimento ($P<0,05$). Hubo una diferencia altamente significativa

entre el nivel y el supernivel de los miembros superiores ipsilaterales de los atletas (P<0,05). Conclusión: Los levantadores de pesas que practicaron ejercicios de fuerza del núcleo abdominal mejoraron significativamente la estabilidad dinámica de los miembros inferiores. La estabilidad del movimiento de las extremidades superiores de los jóvenes levantadores de pesas es más simétrica durante el ejercicio de fuerza del núcleo abdominal. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Núcleo Abdominal; Fuerza Muscular; Aptitud Física; Levantamiento de Peso.*

DOI: http://dx.doi.org/10.1590/1517-8692202329012022_0594 Article received on 31/10/2022 accepted on 11/11/2022

INTRODUCTION

Weightlifting is an ability-based sport. Strength and control of a lifter are paramount in competition. The pioneers in the field of weightlifting set one fantastic record after another. Athletes' improvement in speed and ability is inseparable from regular exercise. Strength training is an integral part of all sports. It is the basis for improving players' physical fitness and overall development.[1] However, the strength requirements of weightlifters are very high. Men's weightlifting requires more strength. Weightlifters do not have enough strength to win without rigorous training. In training, athletes must strictly abide by the principles of strength training to effectively improve their strength and physical fitness. This is how athletes can stand out in competitions.

This paper tests FMS and Y-Balance for young male weightlifters before core strength exercises. This paper studies its changes before and after training. This provides scientific and reasonable training and education guidance for young athletes to cultivate and maintain their advantages.[2] Core strength is the main driving force of every part of the human body. It is the main factor in maintaining the body's center of gravity from sports injuries. The level of core strength is directly related to the athlete's ability to control the limbs during exercise. Athletes improve their endurance and flexibility through training methods such as stability exercises, strength training, and explosive power exercises. This can prevent muscle strain during exercise and enhance the body's sense and response. Through core training, the inappropriate posture and mechanical structure of humans can be changed, and humans' exercise intensity, stability, and manipulation ability can be enhanced.

METHOD

Research objects

In this study, 26 young male weightlifters were selected, and the subjects had not previously undergone systematic core strength training. (1) Y-Balance test. In this paper, balance (YBT) was used to measure the upper limb mobility of the subjects. (2) This paper adopts the experimental teaching method. The content includes alternately active straight leg lift, supine push-up wall, supine turn, double-legged ball, kneeling, single-leg and single-hand extension, half-kneeling balance, half-kneeling balance, half-kneeling around the neck, etc. This core strength workout will last for 24 weeks, 3-4 times a week, with 6-26 movements each time.[3] The athlete does a full-body muscle relaxation before each exercise.

Human body 3D modeling and weightlifting simulation

$\eta(t)=\Sigma_{i=1}^{n}q_i^2(t)$. $y=\Re q/\Re m$ is the Jacobian matrix of the residual vector function , then the iterative solution of $min(\eta(t))$ is:

$$t_{n+1}=\frac{t_n-(F^TF)^{-1}F^Tq(t_n)}{\eta+\varepsilon(t)}=\frac{t_n+\sigma_n}{\eta+\varepsilon(t)} \quad (1)$$

In this paper, the objective function in the optimization algorithm is defined as a weight combination based on three features

$$\beta(\lambda_t)=\frac{\lambda_1\beta_1+\lambda_2\beta_2+\lambda_3\beta_3}{\lambda_1+\lambda_2+\lambda_3} \quad (2)$$

β_1, β_2, β_3 represents the characteristics of grayscale, contour, edge, and so on, respectively. We established the corresponding objective function accordingly. It can be obtained from the formula (1). We define the objective function $\beta_m(\lambda_t)$ as

$$\beta_m(\lambda_t)=\Sigma_{i=1}^{n}\Sigma_{j=1}^{m}\left(\frac{\lambda_t(t_j^i)-\lambda_{t-1}(t_j^{i-1})}{\lambda_t(t_j^i)+\lambda_{t-1}(t_j^{i-1})}\right)_i^2 \quad (3)$$

Statistical methods

This paper uses SPSS19.0 software to organize and analyze the original data.

ETHICAL COMPLIANCE

Research experiments conducted in this article with animals or humans were approved by the Ethical Committee and responsible authorities of Hebei Construction Material Vocational and Technical College following all guidelines, regulations, legal, and ethical standards as required for humans or animals.

RESULTS

Analysis of lower limb Y-Balance test results

The lower body YBT-LQ is used to compare the left and proper symmetry of the test results of the players in the Medial, Anterior, Lateral, and other directions. Experiments in the Antel direction before cardio strength training found that the deviation between the left and right legs of 4 people was more significant than or equal to 4 cm, and the movement stability of the left side was better than that of the right side.[4] The individual differences of athletes in the Medial direction are relatively small. The distance between the left and right legs of the eight players is greater than or equal to 4cm. The stability of the left leg of the four players is better than that of the right leg. The distance between the left and right legs was more significant than or equal to 4 cm in 9 of the 26 patients in the lateral direction. Eight patients had better left-side stability than right-side stability. (Tables 1 to 3)

Analysis of the results of the upper limb Y-Balance test

Upper limb YBT-UQ is further divided into Medial, Inferior, and Superior. Twelve athletes scored above a fixed value (4 cm) on two upper body tests during core strength training. Twelve athletes scored higher on the left than on the right. The remaining 12 athletes scored higher on the left than on the left. The difference between the left and right sides in the experiment in the Inferior direction was significant, in which the deviation of 14 subjects exceeded a fixed value.[5] Thirteen

Table 1. Comparison of left and proper trials of YBT-LQ.

	Left before exercise intervention	Left after exercise intervention	Difference
Anterior	56.01 ± 18.86	64.23 ± 9.84	P<0.05
Medial	96.43 ± 25.99	105.36 ± 6.07	P<0.05
Lateral	92.55 ± 26.84	104.49 ± 7.15	P<0.05

Table 2. Comparison of test results before and after the right side of YBT-LQ.

	Left before exercise intervention	Left after exercise intervention	Difference
Anterior	54.07 ± 18.61	63.22 ± 9.77	P<0.05
Medial	94.32 ± 24.69	103.43 ± 6.69	P<0.05
Lateral	94.51 ± 25.79	103.44 ± 7.3	P<0.05

Table 3. Comparison of the difference between the left and right sides of the YBT-LQ before and after the test.

	Left before exercise intervention	Left after exercise intervention	Difference
Anterior	3.46 ± 5.89	3.02 ± 5.07	P>0.05
Medial	4.38 ± 3.48	3.44 ± 2.92	P>0.05
Lateral	3.81 ± 3.89	3.5 ± 3.26	P>0.05

of them scored better on the left than on the right. The right side of the 13 people is better than the left. In the "super" direction, 14 of the 26 subjects tested left and right by more than a constant. Only five of the other 26 subjects scored higher on the left than on the outside. The other seven are better on the right than the left.

In short, in the YBT-UQ test, the left side of the Interior direction performed better than the right before completing the core ability training. Still, it was the opposite in super ability. After the central strength training, the scores of the three aspects of the ipsilateral upper limb were improved, and there was no significant difference between the left and right groups. There were significant differences in the exercise capacity and superpower levels of the athletes' ipsilateral upper limbs before and after the intervention. The test results show that core strength training can improve the stability of the lower limbs and the upper limbs.[6] Tables 4-6 show a significant difference in YBT of the upper limb, left and right lower limb before and after exercise. Young male weightlifters have more symmetrical upper body movement stability during core strength training.

DISCUSSION

This paper showed significant differences in the anterior direction in the YBT-LQ test before the subjects were subjected to strength exercises. More people scored more with their left foot than their right. This shows that the stability of the left foot is better than that of the right foot in the anterior direction.[7] All three aspects of the ipsilateral leg improved significantly after core strength training. There are apparent differences in the three aspects before and after core strength training. The results show that athletes using core strength to exercise can significantly improve the movement stability of the lower limbs. Core strength exercises can stabilize the pelvis and spine, keep the trunk in a normal posture, and effectively prevent sports injuries.[8] Core strength exercise can improve the dynamic stability of the athlete's limbs and the movement stability of the upper limb and left leg. This achieves a better balance.

Table 4. Comparison of test results before and after intervention on the left side of YBT-UQ.

	Left before exercise intervention	Left after exercise intervention	Difference
Anterior	83.4 ± 8.25	83.06 ± 8.25	P<0.05
Medial	81.26 ± 8.82	81.29 ± 7.46	P>0.05
Lateral	58.4 ± 7.59	59.31 ± 6.55	P<0.05

Table 5. Comparison of test results before and after intervention on the right side of YBT-UQ.

	Left before exercise intervention	Left after exercise intervention	Difference
Anterior	81.26 ± 22.59	84 ± 7.5	P<0.05
Medial	71.3 ± 21.96	79.07 ± 7.58	P>0.05
Lateral	58.3 ± 7.48	64.46 ± 7.02	P<0.05

Table 6. Comparison of the difference between the left and right-side difference test results of YBT-UQ.

	Left before exercise intervention	Left after exercise intervention	Difference
Anterior	7.2 ± 17.34	7.2 ± 17.34	P>0.05
Medial	10.59 ± 18.61	10.59 ± 18.61	P<0.05
Lateral	9.35 ± 11.99	9.35 ± 11.99	P<0.05

Athletes need 48 hours to recover muscle after high-intensity strength training. This requires a lot of minerals, egg quality, carbohydrates, etc., to recover.[9] On this basis, the strength training program for male weightlifters should be two to three times a week, preferably at intervals. This is how to achieve the purpose of the exercise. Related research shows that male weightlifters have significantly improved physical fitness and muscle strength after two weeks of physical training.

If the athlete does not perform the high-intensity exercise for 2-4 days, the muscle volume and strength will decrease. This suggests that the athlete loses muscle size and strength at rest.[10] Therefore, weightlifters and other sports players should continue physical exercise before and after the competition. However, it should be noted that the number of trainings should be gradually reduced in the weeks before the competition to the week to ensure that the athletes gradually improve their training ability and adaptability requirements.[11] Male weightlifters should perform a physical training session immediately after participating in a sport and 48 hours before the next. If the athlete's game plan is tight, an intense training session should be performed before and before the game.

Segmented strength training is an exercise method widely used by Chinese weightlifters in strength training. Therefore, segmented exercise takes corresponding exercise methods according to different parts of the human body. There are many different approaches to strength training for male lifters.

CONCLUSION

Young men's weightlifters had higher FMS scores after completing core strength training than before the practice. There was a clear difference between the pre-and post-training FMS scores. In this paper, the core strength training method is used to improve the limb movement stability of young weightlifters. This improves the balance of the athlete's upper and left leg.

The authors declare that they have no competing interests.

AUTHORS' CONTRIBUTIONS: Each author made significant individual contributions to this manuscript. Wenjun Bi: writing; Yunna Zhao: data analysis; Hui Zhao: article review and intellectual concept of the article.

REFERENCES

1. Iversen VM, Norum M, Schoenfeld BJ, Fimland MS. No time to lift? Designing time-efficient training programs for strength and hypertrophy: a narrative review. Sports Med. 2021;51(10):2079-95.
2. Saumaa H. Somatic strength training: an alternative to "no pain no gain". Altern Complement Ther. 2020;26(1):19-22.
3. Forner LB, Beckman EM, Smith MD. Symptoms of pelvic organ prolapse in women who lift heavy weights for exercise: a cross-sectional survey. Int Urogynecol J. 2020;31(8):1551-8.
4. Baker K, LaValley MP, Brown C, Felson DT, Ledingham A, Keysor JJ. Efficacy of Computer- Based Telephone Counseling on Long- Term Adherence to Strength Training in Elderly Patients with Knee Osteoarthritis: A Randomized Trial. Arthritis Care Res. 2020;72(7):982-90.
5. Nuzzo JL. History of strength training research in man: An inventory and quantitative overview of studies published in English between 1894 and 1979. J Strength Cond Res. 2021;35(5):1425-48.
6. Shurley JP, Ednie AJ, Rudebeck TJ. Strength and conditioning practices of head coaches of male and female interscholastic sport teams. J Strength Cond Res. 2020;34(7):1894-902.
7. Jawade S, Naidu N, Vardharajulu GG. Efficacy of strength training program on muscle performance by determining 1 repetition maximum in adults. Eur J Mol Clin Med. 2020;7(2):1946-54.
8. Chisati EM, Constantinou D, Lampiao F. Effects of maximal strength training on bone mineral density in people living with HIV and receiving anti-retroviral therapy: a pilot study. BMC Sports Sci Med Rehabil. 2020;12(1):1-7.
9. Hermassi S, Laudner K, Schwesig R. The effects of circuit strength training on the development of physical fitness and performance-related variables in handball players. J Hum Kinet. 2020;71(1):191-203.
10. Helgerud J, Thomsen SN, Hoff J, Strandbråten A, Leivseth G, Unhjem R, et al. Maximal strength training in patients with Parkinson's disease: impact on efferent neural drive, force-generating capacity, and functional performance. J Appl Physiol. 2020;129(4):683-90.
11. Sánchez-Moreno M, Cornejo-Daza PJ, González-Badillo JJ, Pareja-Blanco F. Effects of velocity loss during body mass prone-grip pull-up training on strength and endurance performance. J Strength Cond Res. 2020;34(4):911-7.