EFFECTS OF FUNCTIONAL STRENGTH TRAINING ON SPRINTERS' STRENGTH

EFEITOS DO TREINAMENTO DE FORÇA FUNCIONAL SOBRE A FORÇA DOS VELOCISTAS

EFECTOS DEL ENTRENAMIENTO DE FUERZA FUNCIONAL EN LA FUERZA DE LOS VELOCISTAS

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ABSTRACT

Introduction: The exercise of functional strength in a sprinter can play an essential performance gain to propulsion. Functional training can significantly affect the sprinter, preventing injury and making better use of physical training. The sprint interval training method has been widely recognized and applied. Objective: This paper explores the effect of functional strength training by the sprint interval training method on the strength quality of sprinters. Methods: This paper uses random sampling to select 30 male college sprinters as research subjects. The volunteers were divided into two groups according to the performance of the 100-meter speed project: All the essential data of the subjects who passed the T-test were without statistical difference P>0.05. Both groups perform daily training. Functional strength training was added to the experimental group by interval start training with a full 12-week cycle. The strength data of the athletes were measured before and after the experiment, measured, and discussed statistically. Results: The indicators showed significant differences, except for the normal left supine position support test, unchanged by the presented intervention(P<0.01). After the experiment, all indicators were statistically significant compared to the control group (P<0.01). The performance of the groups in the ball exercise, static jump, and vertical jump was significantly improved (P<0.01). Conclusion: Functional strength exercise can improve sprinters' body control and stability. The sprint interval method can also improve the speed of upward force transmission. This conclusion is significant for formulating the strength training plan designed for sprinters. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Running; Resistance Training; Sprint Interval Training.

RESUMO

Introdução: O exercício da força funcional no velocismo pode desempenhar um ganho de performance essencial à propulsão. O treinamento funcional pode afetar significativamente o velocista, tanto na prevenção de lesões quanto ao melhor aproveitamento do treinamento físico. O método de treinamento intervalado de arranque tem sido amplamente reconhecido e aplicado. Objetivo: Este artigo explora o efeito do treinamento de força funcional pelo método de treinamento intervalado de arranque sobre a qualidade da força dos velocistas. Métodos: Este artigo usa amostragem aleatória para selecionar 30 velocistas universitários masculinos como objetos de pesquisa. Os voluntários foram divididos em dois grupos de acordo com o desempenho do projeto de 100 metros de velocidade: Todos os dados essenciais dos sujeitos que passaram no teste T foram sem diferença estatística P>0,05. Ambos os grupos realizam um treinamento diário. Ao grupo experimental foi acrescentado o treinamento de força funcional pelo treinamento intervalado de arranque com ciclo completo de 12 semanas. Os dados de força dos atletas foram mensurados antes e após o experimento, mensurados e discutidos estatisticamente. Resultados: Os indicadores demonstraram diferenças significativas, exceto para o teste normal de apoio à posição supina esquerda, inalterado pela intervenção apresentada (P<0,01). Após o experimento, todos os indicadores foram estatisticamente significativos em comparação com o grupo controle (P<0,01). O desempenho dos grupos em exercício de bola, salto estático e salto vertical foram significativamente aprimorados (P<0,01). Conclusão: O exercício de força funcional pode melhorar o controle e a estabilidade corporal dos velocistas. O método de treinamento intervalado de arranque também pode melhorar a velocidade de transmissão de força ascendente. Essa conclusão é significativa para a formulação no plano de treinamento de força destinado à velocistas. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Corrida; Treinamento de Força; Treinamento Intervalado de Arranque.*

RESUMEN

Introducción: El ejercicio de la fuerza funcional en los velocistas puede suponer una ganancia de rendimiento esencial para la propulsión. El entrenamiento funcional puede afectar significativamente al velocista, tanto en la prevención de lesiones como en el mejor aprovechamiento del entrenamiento físico. El método de entrenamiento por intervalos de sprint ha sido ampliamente reconocido y aplicado. Objetivo: Este artículo explora el efecto del entrenamiento de fuerza funcional mediante el método de entrenamiento de intervalos de sprint en la calidad de la fuerza de los velocistas. Métodos: Este artículo utiliza un muestreo aleatorio para seleccionar 30 velocistas universitarios como sujetos de investigación. Los voluntarios se dividieron en dos grupos según el rendimiento del proyecto de velocidad de 100 metros: Todos los datos básicos de los sujetos que superaron el test-T fueron sin diferencia estadística P>0,05. Ambos *grupos realizan un entrenamiento diario. Al grupo experimental se le añadió el entrenamiento de fuerza funcional por intervalos de sprint con un ciclo completo de 12 semanas. Los datos de fuerza de los atletas se midieron antes y después del experimento, y se analizaron estadísticamente. Resultados: Los indicadores mostraron diferencias significativas, a excepción de la prueba normal de apoyo a la posición supina izquierda, no modificada por la intervención presentada (P<0,01). Tras el experimento, todos los indicadores fueron estadísticamente significativos en comparación con el grupo de control (P<0,01). El rendimiento de los grupos en el ejercicio con balón, el salto estático y el salto vertical mejoró significativamente (P<0,01). Conclusión: El ejercicio de fuerza funcional puede mejorar el control corporal y la estabilidad de los velocistas. El método de entrenamiento por intervalos de sprint también puede mejorar la velocidad de transmisión de la fuerza ascendente. Esta conclusión es significativa para la formulación en el plan de entrenamiento de fuerza para los velocistas.* ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Carrera; Entrenamiento de Fuerza; Entrenamiento por Intervalos de Sprint.*

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INTRODUCTION

Functional strength training focuses on multi-joint, multi-faceted and all-around exercises for athletes. Functional strength exercises are more diverse than conventional physical exercise methods. It can enable athletes to gain their state advantages to enhance their body's function. This training method can effectively prevent sports injuries. This article uses 12 weeks of functional strength training for college sprinters.[1] We observed changes in core stability, functional strength, dynamic flexibility, and sport-specific abilities. This paper analyzes the effect of core stability exercise on athletes. The research results of this paper provide some reference for the formulation of future training plans for other professional athletes.

METHOD

Research objects

Thirty college boys are used as experimental materials to conduct research. In this paper, the volunteers were divided into two groups according to the 100-meter sprint project performance: one group was the control group, and the other was the experimental group.[2] All essential data of subjects who passed the T-test were P>0.05. The data were not statistically significant. (Table 1)

Research methods

Soccer players conducted teaching trials and tests in the corridors of the track and field venue and research building. The training period was 12 weeks, with four weekly training sessions.[3] The time for each training in the preparation part of the sprint training class is 30 minutes.

The control group only performed daily training (4 times per week, 60-90 minutes). The experimental group also performed 30 minutes of functional strength training and routine daily training. The whole test takes two days. Cardiac stability was assessed using McGill's somatic rhinometry. The test content is trunk flexion and extension and lateral support. Lateral support measures the level of muscular endurance in the core area in support time units. Each trial took 5 minutes to remove fatigue effects.[4] This article uses medicine balls, pull-ups, vertical jumps, and other methods to test physical function. The drill grid was used in this paper to conduct the flexibility test. The 100m sprint is measured using Speed Smart's infrared speedometer.

Table 1. Basic information on experimental subjects.

Group	Control group	Test group
Age	23.26±2.74	24.95±2.32
Height/cm	186.95±7.05	184.32±7.58
Weight/kg	71.26±5.79	69.05±7.79
Years of amateur training	8.11±4.11	8.95±4.63
100 special grades/s	12.24±0.34	12.28±0.28

Mathematical modeling of optimal sprint speed

The best sprint speed core is an optimized movement speed distribution. This is a highly complex issue. It involves movement and physiology. This paper proposes a new computing model.

Model Assumptions

1. The race distance is S. The time for the player to complete the task is T. The rate is $u(t)$. 2. In the competition, the proportional relationship between the wind speed F and the speed u is the speed u. 3. During the printing process, the internal and external wind resistance k are proportional to the movement rate $u(t)$. The scale factor is $u(t)$.

Modeling

It can be seen from the calculus that the distance of the race is the integral of the speed $u(t)$ at $[0, T]$ of the interval:

$$S = \int_0^T u(t)dt \qquad (1)$$

How to allocate $u(t)$ to minimize T when S is fixed. How to allocate $u(t)$ to maximize S when T is fixed. These two problems are equivalent, and it can be seen from equation (1) that the second problem is easier to solve. Speed $u(t)$ is determined by the runner's physical fitness and resistance during a sprint. Assuming the player's thrust is $g(t)$, then get $\omega c + k + R = g$ according to Newton's second theorem.

$$\begin{cases} \dfrac{du}{dt} + \dfrac{u}{\lambda} + \dfrac{u}{\alpha} = g(t) \\ u(0) = 0 \end{cases} \qquad (2)$$

Both $1 / \lambda$ and $1 / \alpha$ are suitable resistance factors, while $g(t)$ is a variable within the athlete's grasp.[5] The problem reduces to finding the optimal strategy for $g(t)$. When T is fixed, the maximum value is obtained with S shown in equations (1) and (2). $g(t)$ is usually limited by two conditions: The second is the player's maximum momentum F:

$$g(t) \le G \qquad (3)$$

Second, the energy consumed per unit time is the product $g\square u$ of the athlete's momentum and speed.[6] The consumption rate $g\square u$ of physical strength is determined according to the equivalent oxygen supplied by the body. $Y(t)$ represents the energy equivalent to oxygen stored in human muscles, and ρ refers to the energy equivalent to oxygen supplied in a certain period.

$$\begin{cases} \frac{dY}{dt} = \rho - g * u \\ Y(0) = Y_0 \end{cases} \quad (4)$$

Y_0 is the initial value of stored energy in the body.

Assuming that four physiological parameters G, λ, ρ, Y_0 and one external parameter α are all to achieve (2)(3) and (4) equations $u(t)$, S is the largest under the condition that T is fixed. Because there are three uncertain functions $u(t)$, $Y(t)$, $g(t)$ in the problem, appropriate assumptions must be made about them.

Data Analysis

The processing of statistical data was carried out on SPSS for Windows 13.0. These data are expressed herein as "M±SD." In this paper, the T-test was used for comparison between groups. The significance level was taken as 0.05.

Ethical Compliance

Research experiments conducted in this article with animals or humans were approved by the Ethical Committee and responsible authorities of Department of Physical Education, Dong-A University and Department of Leisure Services and Sports, Paichai University following all guidelines, regulations, legal, and ethical standards as required for humans or animals.

RESULTS

Changes in core stability before and after training

Table 2 shows that McGill's core stability index increased significantly before and after training ($P<0.01$), and all parameters in the control group were statistically significant ($P<0.001$). Twelve weeks of routine training in the control group and core training in the experimental group improved trunk muscle endurance.[7] There are different degrees of difference between the two groups of left and the proper support. Explain that in training, attention should be paid to controlling body posture to ensure the quality of the movement.

After the experiment, the overall core stability of the two groups was significantly increased ($P<0.001$). The difference between the experimental and control groups was statistically significant ($P<0.01$). Athletes must also add bare waist and abdominal exercises to their regular physical training.[8] In the experimental group, the overall stability of the core area was further improved due to Swiss ball training.

Changes in functional strength and dynamic flexibility during the 100-meter test

Table 3 shows that the performance of the medicine ball, pull-up, and vertical jump after the two athletes were significantly improved compared with before the training.[9] After functional strength training, the athletes in the experimental group had statistical significance in the score of pull-up and forward push medicine ball ($P<0.01$). Although the exercise performance of the experimental group was significantly improved than that of the control group ($P<0.01$) before the exercise, its development speed was significantly greater than that of the control group ($P<0.05$). The stabilization strength exercises described in this course effectively improve body control and dynamic stability. At the same time, this training can improve the power transmission efficiency from the bottom up.

Table 2. Changes in McGill Core Stability Test before and after training s.

Name	Control group		Test group	
	Before training	After training	Before training	After training
Torso flexion	54±7.47	59.58±10	54.74±7.16	74±7.89
Trunk stretch	45.37±7.26	51.79±7.79	48.11±7.79	61.68±8.53
Left side support	40.95±6.32	45.58±7.26	38.53±7.37	49.89±6.21
Right side support	39.58±5.89	43.68±6.95	42.63±7.05	52.21±6.32
Overall Core Stability	180±21.16	200.63±27.16	184±19.37	237.68±23.47

Table 3. Changes in functional strength, dynamic flexibility, and 100m test scores before and after training.

Name	Control group		Test group	
	Before training	After training	Before training	After training
Forward solid ball/m	5.99±0.45	6.88±0.67	6.17±0.49	7.64±0.46
Pull-ups/reps	9.16±2	11.79±1.68	8.21±1.37	15.58±2.42
Vertical jump/cm	25.26±4.84	26.11±5.05	23.89±2.95	28.32±2.63
Drill fence test/cm	67.68±9.79	70.53±8.42	71.26±8.11	67.05±8.53
100m run/s	12.32±0.93	12.32±1.01	12.21±0.77	12.11±0.88

There was no significant difference between the two experimental groups in the vertical jump ability test because the index of the jump test was leg strength. It provides energy to the phosphate system. During this process, the muscles contract with maximum intensity. A core-stabilizing strength workout is powered by anaerobic glycolysis. The results showed no significant difference in longitudinal jumping ability between the two groups.

In the drill grid test, this paper mainly examines the flexibility, dynamic balance, core strength, and control of the core of the lower limbs. There was no significant difference in flexibility measurement between the two experimental groups before and after training ($P>0.05$). After the experiment, the difference between the two groups was not statistically significant ($P>0.05$). The reason is the lack of purpose of daily flexibility. Athletes did a simple static stretching exercise before and after training.[10] This resulted in no change in tests of motor flexibility. In addition, the height of the grid in each stage of this experiment changed to 8 cm, and the range was more extensive. This is also a factor in which there was no significant difference in the study.

DISCUSSION

Sprint functional strength is built on an integral movement chain. This paper mainly analyzes the interaction of various bones, joints, and muscle groups in the body and the changes in movement rules.[11] Professional strength exercises for the joints and muscles of the athlete's body can enhance the stability of the body. Functional strength training achieved improved athletic performance and maximized muscle function. In this paper, applying functional strength training to sprint events can enable athletes to develop lasting strength. This enhances the technical level of the athlete. Functional strength exercises have remarkable effects on sprinting. The human neuromuscular can continuously overcome various external obstacles and negative factors. Athletes' long-term practice will inevitably lead to the accumulation of injuries. This will adversely affect future games. The exercise concept of functional strength demonstrates the function of the coordinated movement chain. Functional strength training focuses more on elasticity training, and training multiple muscles must ensure stability. Only when the coordination of muscles is enhanced will the control of nerves and muscles be significantly enhanced.

CONCLUSION

Functional strength training significantly improves overall control, dynamic stability, and bottom-up power transfer in sprinting. Functional strength training had no significant effect on improving the speed of college students in the 100-meter sprint. Athletes should increase flexibility, lower body explosiveness, energy supply, and other aspects of exercise in functional strength training.

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