MUSCLE STRENGTH COORDINATION TRAINING FOR ATHLETES IN MOUNTAINEERING SPORTS

TREINAMENTO DE COORDENAÇÃO DA FORÇA MUSCULAR DOS ATLETAS EM ESPORTES DE MONTANHISMO

ENTRENAMIENTO DE LA COORDINACIÓN DE LA FUERZA MUSCULAR DE LOS ATLETAS DE DEPORTES DE MONTAÑA

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ABSTRACT

Introduction: Rock climbing is a physical activity that requires excellent physical conditioning. In addition to improving physical fitness and motor coordination, rock climbing requires constant improvements in muscle coordination skill training to enhance its modern tactics. Objective: Explore the muscular coordination skill training of rock climbers. Methods: A random sample of 8 athletes were assigned to the experiment involving the measurement of athletes' body composition, serum creatine kinase and blood urea levels, and other biomarkers collected before and after the trial. Results: There was a significant negative correlation between dynamic balance and motor coordination ability after training in extreme rock climbing sports. On the second day after the rock climbing exercise, the volunteers' body weight and fat content significantly reduced, and the concentration of creatine kinase (CK) and blood urea (BU) increased significantly. Conclusion: The exploration of extreme sports' effect on improving athletes' muscle coordination ability showed that strength and coordination should be enhanced in rock climbing. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Mountaineering; Athletes; Muscle Strength; Psychomotor Performance.

RESUMO

Introdução: A escalada em rocha é uma atividade física que exige excelente condicionamento físico. Além de melhorar a aptidão física e a coordenação motora, a escalada requer aperfeiçoamentos constantes no treinamento de habilidade em coordenação muscular para aprimoramento de suas táticas modernas. Objetivo: Explorar o treinamento da capacidade de coordenação muscular de escaladores em rocha. Métodos: Uma amostragem aleatória composta de 8 atletas foi designada para o experimento envolvendo a mensuração da composição corporal dos atletas, níveis séricos de creatina quinase e ureia sanguínea além de outros biomarcadores coletados antes e após o ensaio. Resultados: Houve uma correlação negativa significativa entre o equilíbrio dinâmico e a capacidade de coordenação motora após o treinamento em esportes radicais de escalada em rocha. No segundo dia após o exercício de escalada em rocha, o peso corporal e o conteúdo de gordura dos voluntários mostrou uma redução significativa, e a concentração de creatina quinase (CK) e ureia sanguínea (BU) aumentaram significativamente. Conclusão: A exploração do efeito dos esportes radicais na melhoria da capacidade de coordenação muscular dos atletas evidenciou que a força e a coordenação devem ser reforçadas no processo de escalada em rocha. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Montanhismo; Atletas; Força muscular; Desempenho Psicomotor.*

RESUMEN

Introducción: La escalada en roca es una actividad física que exige una excelente condición física. Además de mejorar la forma física y la coordinación motriz, la escalada requiere una mejora constante en el entrenamiento de las habilidades de coordinación muscular para optimizar su táctica moderna. Objetivo: Explorar el entrenamiento de las habilidades de coordinación muscular de los escaladores de roca. Métodos: Se asignó una muestra aleatoria compuesta por 8 atletas al experimento que incluía la medición de la composición corporal de los atletas, los niveles de creatina quinasa sérica y de urea en sangre, además de otros biomarcadores recogidos antes y después de la prueba. Resultados: Se observó una correlación negativa significativa entre el equilibrio dinámico y la capacidad de coordinación motriz tras el entrenamiento en deportes extremos de escalada. El segundo día después del ejercicio de escalada en roca, el peso corporal y el contenido de grasa de los voluntarios mostraron una reducción significativa, y la concentración de creatina quinasa (CK) y de urea en sangre (BU) aumentó significativamente. Conclusión: La exploración del efecto de los deportes extremos en la mejora de la capacidad de coordinación muscular de los atletas puso de manifiesto que la fuerza y la coordinación deben mejorarse en el proceso de escalada en roca. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Montañismo; Atletas; Fuerza Muscular; Desempeño Psicomotor.*

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INTRODUCTION

Outdoor rock climbing is an activity that can get close to nature. Currently, most of the research focuses on climbing heights (>4000 m), moderate climbing (2500-3800 m), and climbing. At present, scholars at home and abroad have little research on long-distance field rock climbing on the plateau. Comprehensive quality is the guarantee of comprehensive quality.[1] This is the foundation of learning and applying techniques and strategies. The morning body composition, plasma creatine kinase, urea, urine protein, urine specific gravity, and other indicators were measured before and after rock climbing and the next day. The purpose of this study was to investigate body composition and muscle coordination during a 30km rock climb.[2]

METHOD

Research objects

This paper uses a random sampling method to investigate eight rock climbers. The body composition of the athletes was measured before climbing and early the next morning.[3] Before going up the mountain, on the second day after climbing, serum creatine kinase (CK), blood urea (BU), and urine were tested for ten items. In this article, set up the meter and format the memory before using it. At the same time, the personal data of the subjects were also entered in this paper.[4]

Estimation of energy consumption data

1. Use heart rate to measure energy consumption. Substitute the heart rate data after the test into the prediction formula to analyze the energy consumption. Its calculation formula is as follows:

2. Using a three-axis accelerometer to measure energy consumption. This article will use the software to download the data when the test is over. This paper extracts the three-axis data of GT3X, and the magnitude of the three--axis vector VM3 is one-half of VM3=(ACaxis12+ACaxis22+ACaxis32)1/2.

Modeling method of leg motion

In this paper, a cube mesh with a variable shape is used. The content includes a square leg model.[5] The model is divided into grid cubes by parallel planes in 3 orthogonal directions (U, V, W). This paper assumes that the cube is divided into m segments in the U direction, n segments in the V direction, and k segments in the W direction. The larger the m, n, k, the smoother the deformation. If the value range of U, V, W is normalized to [0,1], the same grid space can be applied to multiple objects. There are a total of $(m+1) \times (n+1) \times (k+1)$ control points in this parallel grid cube. Our ternary tensor product L-spline function consisting of these control points can determine any point in grid space. In $NURBS$ form we have:

$$D(u,\upsilon,\omega)=\frac{\sum_{a=0}^{m}\sum_{b=0}^{n}\sum_{c=0}^{k}P_{abc}W_{abc}B_{a,p}(u)B_{b,q}(\upsilon)B_{c,r}(\omega)}{\sum_{a=0}^{m}\sum_{b=0}^{n}\sum_{c=0}^{k}W_{abc}B_{a,p}(u)B_{b,q}(\upsilon)B_{c,r}(\omega)} \quad (1)$$

D is a deformed object in this model, P is a control point, and W is a weighting function. Both methods are different p, q, r. Both are different parameter bar basis functions. In FFD, it is a parametric coordinate composed of D points, a local coordinate (u, v, ω). Therefore, the determination of the local coordinates of the FFD,[6] that is, the reference coordinates of P and D, are given, and the corresponding node vector and parameter values of the bar basis function are given. The node vector in the primary function is related to the number of B samples and the number of control points, which p, q, r can usually be expressed as:

$$\begin{aligned} 2 \le p \le m+1 \\ 2 \le q \le n+1 \\ 2 \le r \le k+1 \end{aligned} \quad (2)$$

The node vector of the parameter element is

$$u_i=\begin{cases} 0 & i=0 \\ \dfrac{P_{000}P_{(i-1)00}}{P_{000}P_{m00}}*U & 1 \le i \le (m+1) \\ 1 & i=m+2 \end{cases} \quad (3)$$

The node vector calculation method of the parameter sum v and ω is similar. . A recursive algorithm determines $Cox - deBoor$ the function:

$$\begin{aligned} B_{i,1}(u)&=\begin{cases} 1 & u_i \le u \le u_{i+1} \\ 0 & otherwise \end{cases} \\ B_{i,2}(u)&=\frac{u-u_i}{u_{i+1}-u_i}B_{i,1}(u)+\frac{u_{i+2}-u}{u_{i+2}-u_{i+1}}B_{i+1,1}(u) \end{aligned} \quad (4)$$

Data processing and statistical analysis

This study used SPSS 19.0 software for statistics. Energy consumption was compared using a triaxial accelerometer and heart rate method, and the indexes before and after rock climbing were compared. Correlation analysis was performed using the Person correlation method. P<0.05 was considered a statistically significant difference. P<0.01 is very different.

There is no need for a code of ethics for this type of study.

RESULTS

Comparison of energy consumption tests of two different methods

Table 1 shows the average energy consumption measurements for 8 participants from 7:00 to 17:00. There was no significant difference (P>0.05) between the two energy expenditure measures.[7] The energy consumption calculated by heart rate at 7:00 was higher than that calculated by the triaxial accelerometer (P<0.05). The energy consumption calculated by the heart rate at 13:00 is smaller than the energy consumption calculated by the triaxial accelerometer. Pearson correlation analysis showed a very significant correlation between the energy consumption estimated by the heart rate method and the energy consumption calculated by the triaxial accelerometer (P<0.05).

Changes in the trunk and muscle coordination before, after, and after climbing

Table 2 measures body weight, fat content, and lean body mass before climbing and the following day. During rock climbing, the participants' weight decreased significantly (P<0.05). The following day, the weight returned to pre-climbing (P>0.05); despite a 1% weight loss, the difference was not significant compared to pre-climbing

Table 1. Energy consumption (kcal)/hour for two test methods.

Time	Heart rate method	Three-axis accelerometer method	p
7:00	473.75±73.99	310.9±73.33	0.030
8:00	495.97±70.7	477.2±39.14	0.417
9:00	473.93±73.99	459.79±39.99	0.792
10:00	439.37±55.7	407.39±39.4	0.157
11:00	410.95±79.99	417.77±39.99	0.943
12:00	349.21±99.49	397.34±39.11	0.222
13:00	405.77±99.94	511.21±37.74	0.029
14:00	479.93±94.22	431.73±40.22	0.197
15:00	495.9±92.95	430.9±39.72	0.235
16:00	495.91±73.77	447.37±42.42	0.735
17:00	471.24±72.75	449.79±34.07	0.997
Average energy consumption	449.12±75.01	429.71±41.09	0.305

(P>0.05). The following day, the fat content returned to climbing levels (P>0.05). When climbing, water and a small amount of fat are lost. Table 3 determines serum CK, BU, urine specific gravity, and urine protein positive rate. Results: In the control group, serum CK and BU were significantly increased in the morning of the second day (P<0.01); the specific gravity of urine was above 1.030. The positive detection rate of urinary protein was significantly higher than that of the control group (P<0.01).

DISCUSSION

Energy consumption analysis of rock climbing

Energy consumption during rock climbing is an important indicator to measure the activity intensity of rock climbers. On an 11-hour, 30-kilometer field climb, the energy consumption is 310-450 kcal per hour.[8] Pearson correlation analysis showed a significant correlation between the two methods of calculating energy consumption (r=0.761, p=0.017). Athletes from 7:00 to 8:00 is the main activity route within 1 hour after departure. Subjects have plenty of energy and higher speed. This keeps the heart rate at a very high level. The difference of 1 hour between 13:00 and 14:00 is primarily due to the two rest breaks. This results in a longer heart rate at a lower frequency.

Body composition and muscle coordination

The so-called coordination refers to the body's overall coordination and the connection between various tissues. Coordination is a fundamental ability of the human body to do things.[9] The ability of an athlete to master the body is directly related to the technical level of the athlete. Athletes' coordination training can enhance the training of various body tissues. At this moment, the body's reaction ability has been dramatically improved. The athlete's movement completion has significantly been improved. The better the athlete's coordination, the stronger the control over the body.[10] Its reaction speed is shortened. The flexibility and balance of the body will allow athletes to achieve higher technical requirements in a short time. Good physical coordination allows athletes to achieve perfect movements. Athletes are also better able to deal with emergencies.[11]

Table 2. Body composition and weight measurements before and after climbing.

Time	Weight (kg)	Lean body mass (kg)	Fat content (%)
Before climbing	60.0±7.0	51.3±7.8	15.01±3.73
After climbing	58.4±5.0	50.5±6.6	14.01±3.41
Next morning	59.9±6.9	51.3±6.9	14.73±3.53

Table 3. Detection of serum calcium, uric acid, urine specific gravity, and urine protein positive rate before and after rock climbing and the following day.

Time	CK(U/L)	BU(mmol/L)	Urine specific gravity (g/ml)	Urine protein positive rate (%)
Before climbing	122.6±48.19	4.64±1.63	1.121±0115	1
Next morning	538.9±91.16	7.53±1.79	≥1.131	81

One study showed that after rock climbing, they lost 3.13 kg. The participants lost weight during climbing sessions that lasted for weeks or weeks. Studies have shown that weight loss is due mainly to eating fewer calories than you eat. Long-term, long-distance outdoor rock climbing consumes 5 kcal per day. Eat fewer calories than you need. The results showed that its energy expenditure was 4319.98±525.95 kcal when climbing in 11 hours.[12] The study of body weight and body composition showed that the subjects lost 2.6 kilograms of body weight and about 1% of their fat. When it comes to climbing, thin people do not change much. After a day's rest, the athletes have reached their pre-climbing level. This suggests that water and small amounts of fat are lost during rock climbing. After another rock climb, the athlete's reserves of energy substances can be well replenished.[13]

The following day, serum CK and BU were significantly increased. Urine-specific gravity was more extraordinary than 1.030, and the positive detection rate of urine protein was over 80%. After 11 hours a day, 30km of rock climbing, this reflects a more robust body response. After one day of recovery, the subjects were still dehydrated. This suggests that proteins involved in long-term rock climbing activities are involved in energy supply. Climbers should supplement after exercise. The height of CK athletes was positively correlated with altitude and up and downslope. The experimental results showed that under the action of centrifugal force, the content of CK increased significantly. Therefore, when rock climbing and ensuring the supply of water, sugar, and electrolytes, you should also pay attention to adding total calories.

Exercising and improving body coordination is a continuous overcoming of irrational muscle tension. During this time, the focus is on strengthening the relaxation of the muscles while working. Do not let it turn into a stiff muscle while exercising. Athletes should do more light exercises after training. Exercising for a long time without knowing how to relax can lead to muscle stiffness. This severely hinders the skill and technique of the rock climber. This makes it more challenging to exercise physical coordination. Pay attention to overcoming little muscle tension during training. In training, athletes should choose appropriate training methods according to more incredible difficulty and difficulty characteristics. This allows athletes to overcome little muscle tension during training consciously. Only in this way can athletes better master more sports skills. This provides a solid foundation for enhancing physical coordination.

CONCLUSION

Genetic factors, the development level of sports quality, and the proficiency of rock climbers' sports technical movements are the main factors that affect the athletes' physical coordination. The physical coordination of rock climbers must be exercised effectively for their physique. Athletes must overcome irrational muscle tension. Building muscle coordination is done in steps. Athletes should pay attention to the appropriate exercise load and use various exercise methods in training.

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