FLEXIBILITY TRAINING IMPROVES ELEGANCE IN ICE BALLET

TREINAMENTO DE FLEXIBILIDADE MELHORA A ELEGÂNCIA DO BALÉ NO GELO

EL ENTRENAMIENTO DE LA FLEXIBILIDAD MEJORA LA ELEGANCIA EN EL BALLET SOBRE HIELO

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ABSTRACT

Introduction: Ice ballet is performed through various movements with high artistic attributes such as skating, foot movement, rotation, and jumping on ice. The development of ice ballet flexibility can make the movements more graceful and coordinated and improve muscle strength. The athlete's flexibility can prevent accidents and reduce injuries. Objective: This study aimed to analyze the effect of body flexibility on improving movement skills in ice ballet. Methods: This paper selects ten ice ballet athletes as the object of research. The physiological and biochemical indicators of the athletes are examined by employing literature, experience, and data statistics. An investigation of the effect of physical flexibility on the performance of ice sports is carried out. Results: The athletes exhibited high flexibility, and their muscles, tendons, and ligaments evidenced improved elasticity and extensibility. There is a correlation between body fat and flexibility in the athletes. The athletes exhibited no metric difference in body composition after the competition. Conclusion: Flexibility training is significant in improving the movement abilities of athletes. Focusing on flexibility training in athletes' daily training allows them to improve the flexibility and extensibility of their muscles, tendons, and ligaments. There is a correlation between body fat and flexibility in athletes. The athletes had approximately the same body composition metrics after the competition. Focusing on flexibility training during athletes' daily training allows for improved flexibility in sports movements. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Skating; Pliability; Sports; Physical Conditioning, Human; Athletes.

RESUMO

Introdução: O balé no gelo é realizado através de vários movimentos com altos atributos artísticos como patinação, movimento de pés, rotação e pulo no gelo. O desenvolvimento da flexibilidade do balé no gelo pode tornar os movimentos mais graciosos e coordenados e melhorar a força muscular. A flexibilidade do atleta pode prevenir acidentes e reduzir lesões. Objetivo: Este estudo teve como objetivo analisar o efeito da flexibilidade corporal na melhoria das habilidades de movimento do balé no gelo. Métodos: Este trabalho seleciona dez atletas de balé no gelo como o objeto de pesquisa. São examinados os indicadores fisiológicos e bioquímicos dos atletas empregando literatura, experiência e estatísticas de dados. É feita uma investigação sobre o efeito da flexibilidade física sobre o desempenho dos esportes no gelo. Resultados: Os atletas exibiram alta flexibilidade, e seus músculos, tendões e ligamentos evidenciaram melhor elasticidade e extensibilidade. Há uma correlação entre a gordura corporal e a flexibilidade nos atletas. Os atletas não exibiram diferença métrica na composição corporal após a competição. Conclusão: O treinamento de flexibilidade é significativo para melhorar as habilidades de movimento dos atletas. A concentração no treinamento de flexibilidade no treinamento diário dos atletas permite melhorar a flexibilidade e a extensibilidade de seus músculos, tendões e ligamentos. Há uma correlação entre a gordura corporal e a flexibilidade nos atletas. Os atletas tinham aproximadamente a mesma métrica de composição corporal após a competição. A concentração no treinamento de flexibilidade durante o treinamento diário dos atletas permite melhorar a flexibilidade dos movimentos esportivos. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Patinação; Flexibilidade; Esportes; Condicionamento Físico Humano; Atletas.*

RESUMEN

Introducción: El ballet sobre hielo se realiza a través de varios movimientos con altos atributos artísticos como el patinaje, el movimiento de los pies, la rotación y los saltos sobre el hielo. El desarrollo de la flexibilidad del ballet sobre hielo puede hacer que los movimientos sean más gráciles y coordinados y mejorar la fuerza muscular. La flexibilidad del deportista puede evitar accidentes y reducir las lesiones. Objetivo: Este estudio tenía como objetivo analizar el efecto de la flexibilidad corporal en la mejora de las habilidades de movimiento del ballet sobre hielo. Métodos: Este trabajo selecciona como objeto de investigación a diez atletas de ballet sobre hielo. Los indicadores fisiológicos y bioquímicos de los atletas se examinan empleando la literatura, la experiencia y los datos estadísticos. Se lleva a cabo una investigación sobre el efecto de la flexibilidad física en el rendimiento de los deportes sobre hielo. Resultados: Los atletas mostraron una gran flexibilidad, y sus músculos, tendones y ligamentos evidenciaron una mayor elasticidad y extensibilidad. Existe una correlación entre la grasa corporal y la flexibilidad en los deportistas. Los atletas no mostraron diferencias métricas en la composición corporal después de la competición. Conclusión: El entrenamiento de la flexibilidad es importante para mejorar las habilidades de movimiento de los atletas. Centrarse

en el entrenamiento de la flexibilidad en el entrenamiento diario de los deportistas les permite mejorar la flexibilidad y la extensibilidad de sus músculos, tendones y ligamentos. Existe una correlación entre la grasa corporal y la flexibilidad en los deportistas. Los atletas tenían aproximadamente las mismas métricas de composición corporal después de la competición. Centrarse en el entrenamiento de la flexibilidad durante el entrenamiento diario de los deportistas permite mejorar la flexibilidad en los movimientos deportivos. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Patinación; Flexibilidad; Deportes; Acondicionamiento Físico Humano; Atletas.*

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INTRODUCTION

Flexibility is an essential physical quality of the human body. It refers to the movement ability of human joints in different directions and the stretching ability of soft tissues such as muscles and ligaments. Speed skating, ice hockey, freestyle skiing aerial skills, curling, alpine skiing, ice ballet, and other winter sports have high requirements for athletes' flexibility.[1] The development of flexibility in athletes can make movements more graceful and coordinated and improve muscle strength. It has a positive effect on preventing injuries, reducing injury accidents, and promoting physical recovery. Athletes who correctly perform stretching exercises can improve their flexibility and sports skills.[2] Most coaches and athletes of ice ballet in China have realized the importance of stretching exercises. Coaches have included it as an essential part of the conditioning program. The author uses the data access method to study human bones and joints' structure, range of motion, and influence factors. To investigate and analyze the opinions, views, and opinions on the factors affecting the flexibility of ice ballet athletes. At the same time, this paper studies the characteristics and differences of the body composition changes in the pre-competition training of elite ice ballet athletes.[3] In this way, the characteristics of changes in body composition of elite ice ballet athletes before the competition and their impact on body flexibility were discussed.

METHOD

Research objects

This paper selects ten ice ballet athletes as research objects. (Table 1) This paper used the segmental bioelectrical impedance body composition tester to measure 20 electrical impedances in 5 segments. Current flow 250μA. There are eight electrodes on the hands and feet. We measure body impedance in sections.[4] The calculation of the body composition results is done by the module that comes with the instrument. Tested body composition indicators are body fat percentage (%), body fat mass (kg), muscle mass (kg), lean body mass (kg), body water content (L), and body flexibility.

The flexibility of ice ballet athletes

$W1$ indicates torso weight. $W2$ represents the combined weight of the head, neck and arms. Represents FC erector spinal muscle strength that maintains flexion of the spine. θ represents the angle of flexion of the spine to the ground.[5] S represents the shear component. P is the reaction force of S.

When a speed skater is sliding, the forward angle of the trunk is 20º. According to the Chinese human body link parameters, we know that the trunk accounts for about the entire body weight 43%, $W1 = 25.8\text{kg}$.

Table 1. Basic information of elite ice ballet athletes ($\bar{\chi} \pm S$).

Gender	N	Age	Training years	Height (cm)	Weight (kg)
Male	5	17.5±4.8	10.5±4.7	174.6±3.36	65.4±2.88
Female	5	17.2±2.2	10.8±2.8	167.2±3.72	50.6±3.38

The head, neck and arms account for about the entire body weight 17%, $W2$ = head and neck + arms = 10.2kg. We can get $L1 = 32cm$, $L2 = 55cm$, $D = 5cm$ (the erector spinae 5 cm from the spine).

$$\sum M = 0, F * D = W1 * L1 + W2 * / L2$$

$$F = (W1 * L1 + W2 * / L2) / D = 2773.2N$$

The erector spinal muscle strength that maintains the forward flexion of the spine is $F = 2273.2N$

The total extrusion force is $N = F + (W1 + W2) * \sin 20^{\circ} = 2896.3N$

$$NX = N * \cos 20^{\circ} = 2721.6N; NY = N * \sin 20^{\circ} = 990.6N$$

The sheer force is $S = (W1 + W2) * \cos 20^{\circ} = 338.3N$

Statistics method

This article regularly measures the proportions of body composition and nutrients in athletes, and we process the data in Microsoft Excel 2016. We calculate the mean and standard deviation.[6] A one-sided test $P<0.05$ was considered significant.

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

RESULTS

Body composition characteristics of male ice ballerinas

There was a significant change in the weight of male ice ballet athletes between the 5th and the 1st measurement. There was a significant change in body fat between the 5th and the 1st time.[7] There was no significant change in muscle mass. The change in lean body mass decreased gradually and did not change significantly. There was a significant change in body water content between the 5th and 1st. There was a significant change in the percentage of physique between the 5th and the 1st time. Athletes' flexibility can be maintained to optimal levels before the competition. (Table 2)

Characteristics of body composition of female ice ballerinas

There was a significant change in the weight of the Naxi ice ballerinas between the fifth and first measurements. There was a significant change in body fat between the 6th and the 1st time. There was no significant change in muscle mass. There was also no significant change in lean body mass.[8] There was a significant change in body water content between the 5th and 1st. There was a significant change in the percentage of constitution between the 6th and the 1st time. Athletes' flexibility can be maintained to optimal levels before the competition. (Table 3)

DISCUSSION

Analysis of body composition characteristics of elite ice ballet athletes

Ice ballet is a skill-oriented sport that is difficult to perform. Ice ballet is a sport with anaerobic energy supply as the primary and aerobic energy

Table 2. Characteristics of body composition changes of elite male ice ballet athletes ($\bar{\chi} \pm S$).

Body composition	Weight (kg)	Body fat (kg)	Muscle mass (kg)
First	65.76±8.22	9.75±2.49	53.82±7.22
second	65.58±8.08	9.36±2.54	53.76±7.22
third	65.53±7.85	9.06±2.02	53.76±7.43
fourth	64.73±8.28	9.23±2.59	53.05±7.22
fifth	63.82±20.20	7.60±2.66	52.80±8.52
sixth	63.83±20.22	7.68±2.07	52.78±8.26
Body composition	Lean body mass (kg)	Body water content (L)	Body fat percentage (%)
First	58.30±8.40	42.86±6.28	13.31±1.48
second	57.88±7.87	42.65±5.86	12.75±1.54
third	56.32±7.74	42.46±5.87	12.28±1.01
fourth	56.20±7.80	42.83±5.70	12.55±1.58
fifth	55.53±8.86	42.23±6.38	11.76±1.66
sixth	56.40±8.63	42.43±6.36	12.01±2.07

Table 3. Characteristics of body composition changes of elite female ice ballet athletes ($\bar{\chi} \pm S$).

Body composition	Weight (kg)	Body fat (kg)	Muscle mass (kg)
First	52.48±3.24	11.91±1.34	39.73±4.06
second	50.65±3.09	11.35±1.96	38.85±2.76
third	50.06±3.22	11.48±1.98	38.80±3.09
fourth	50.45±3.20	11.35±1.53	38.25±0.90
fifth	50.50±3.02	9.65±1.78	38.08±2.36
sixth	50.45±3.52	9.31±1.79	38.00±2.70
Body composition	Lean body mass (kg)	Body water content (L)	Body fat percentage (%)
First	42.23±3.53	30.78±2.52	19.13±1.34
second	40.96±3.05	30.33±0.99	19.11±1.96
third	40.70±3.29	30.60±2.46	18.48±1.98
fourth	40.73±0.89	29.98±0.54	17.96±1.53
fifth	40.65±2.22	29.33±0.68	18.11±1.78
sixth	40.06±2.75	30.00±2.05	17.31±1.79

supply as a supplement. VO2 max training stimulates the production of mitochondria in red blood cells. Mitochondria are energy factories.[9] An adequate energy supply can promote the enhancement of cytochrome oxidase activity. The number of capillaries also increases. This accelerates the diffusion rate of lactic acid. It enhances the body's ability to tolerate lactic acid. Some scholars believe that the absolute value of VO2 max is a better predictor of aerobic capacity in ice ballet athletes. There is a particular relationship between the performance of ice ballet athletes and their weight. In the daily systematic training of ice ballet athletes, it is indispensable for coaches and researchers to monitor the body composition of athletes in real-time. An athlete's body composition is related to certain physiological functions and athletic ability. Both Tables 2 and 3 show that the body composition of the athletes gradually decreased. They achieved optimal body weight, body mass percentage, lean body mass, and other metrics during the competition period. Ballet on ice is a project that is difficult to express. Athletes have muscular aerobic endurance.[10] An athlete's body composition also has many degrees of influence on its specific movement speed and specific explosive power. An athlete's performance in competition may also reflect body composition characteristics.

Influence of body flexibility on gracefulness in an ice ballet

Sports training theory believes that flexibility develops quickly and is easy to achieve. Flexibility disappears when athletes stop training for a little longer. Athletes in the range-of-motion stage should schedule daily exercises to develop flexibility. Athletes can schedule no more than four times a week in the hold phase. However, exercises to develop or maintain flexibility should be scheduled during any training period throughout the year. Ice ballet athletes have different training methods, means, quantity, and intensity, and their flexibility shows significant differences.[11] Exercises that develop flexibility allow each joint to reach its maximum range of motion. In this way, the potential of the athlete can be fully tapped. This improves flexibility.

The athlete's flexibility training load intensity is mainly controlled and arranged by the athlete's "subject kinematic perception." The effort can be reduced when the athlete feels muscle soreness. Hold on when the athlete feels muscle pain. The athlete needs to stop training when the muscles feel numb. Generally speaking, the effect of long-term moderate-intensity pulling exercises is better than that of short-term high-intensity exercises. Flexibility training load intensity determines the effect of developing flexibility.[12] The amount of time an ice baller can practice to develop flexibility should be based on the purpose of the training session. For training sessions that develop athletes' flexibility, the practice time should be set between 60-90 minutes. Exercises to develop flexibility in standard training sessions should be performed after warm-up activities. The practice time is generally about 20 minutes.[13] Although stretching exercises for relaxation can also promote the development of flexibility, long-term muscle work will cause fatigue. Decreased elasticity, stretchability, and excitability result in imperfect muscle contraction and relaxation. Muscle groups do not work in harmony, resulting in reduced joint flexibility. At this time, it should be mainly to eliminate the body's exercise fatigue. Practice time is generally about 35min or more extended. The time for each group of continuous practice is 6-12s, and the swing action can be slightly longer. When doing static exercises, the athlete can stay for a fixed time of about 30s. Practice time plays an essential role in developing the flexibility qualities of ice ballet athletes.

CONCLUSION

Changes in the body composition of elite ice ballet athletes before competition may impact the athlete's flexibility. There are differences in body composition between elite male and female ice ballet athletes. It is mainly manifested in the percentage of body fat (fat content. This may also be one of the factors that male athletes are superior to female athletes in certain sports. The muscles, tendons, and ligaments have better elasticity and stretchability. Athletes should strengthen their training body flexibility in daily training.

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REFERENCES

1. Kato K, Otoshi KI, Tominaga R, Kaga T, Igari T, Sato R, et al. Influences of limited flexibility of the lower extremities and occurrence of low back pain in adolescent baseball players: a prospective cohort study. J Orthop Sci. 2022;27(2):355-59.
2. Nuzzo JL. The case for retiring flexibility as a major component of physical fitness. Sports Med. 2020;50(5):853-70.

3. Bryant LM, Duncan RJ, Schmitt SA. The cognitive benefits of participating in structured sports for preschoolers. Early Educ Dev. 2021;32(5):729-40.
4. Ramon X, Xu Q, Billings AC. Lost in the Vault?: Demonstration Sports at the Winter Olympics and How Digital Media Can Bring Them 'Back to the Future'. Int J Hist Sport. 2020;37(13):1300-21.
5. Kreimer S. An Epileptologist Glides Toward Higher Heights in Figure Skating Competitions. Neurology Today. 2022;22(3):30-1.
6. Malek S, Reinhold EJ, Pearce GS. The Beighton Score as a measure of generalised joint hypermobility. Rheumatol Int. 2021;41(10):1707-16.
7. Lévesque J, Rivaz H, Rizk A, Frenette S, Boily M, Fortin M. Lumbar multifidus muscle characteristics, body composition, and injury in university rugby players. J Athl Train. 2020;55(10):1116-23.
8. Scanaliato JP, Chasteen J, Polmear MM, Salfiti C, Wolff AB. Primary and revision circumferential labral reconstruction for femoroacetabular impingement in athletes: return to sport and technique. J Arthrosc Relat Surg. 2020;36(10):2598-610.
9. Kowalczyk AD, Geminiani ET, Dahlberg BW, Micheli LJ, Sugimoto D. Pediatric and adolescent figure skating injuries: a 15-year retrospective review. CJSM. 2021;31(3):295-303.
10. Herrick SS, Rocchi MA, Couture AL. A Case Study Exploring the Experiences of a Transgender Athlete in Synchronized Skating, a Subdiscipline of Figure Skating. J Sport Soc Issues. 2020;44(5):421-49.
11. Ericsson I. Aerobic or Motor Skills Exercise? What about their Impact on Academic Achievements?. J Sports Med. 2020;53(10):640-7.
12. Naserpour H, Khaleghi Tazji M, Letafatkar A. Immediate Effect of Cryotherapy on the Kinetic Factors Associated with Injury during the Side-Cutting Maneuver in Healthy Male Athletes: Pilot Study. JRM. 2020;9(2):1-8.
13. Deans C, Pini S. Skilled performance in Contact Improvisation: the importance of interkinaesthetic sense of agency. Synthese. 2022;200(2):1-17.