PREVENTION OF KNEE JOINT INJURIES IN WINTER SPORTS TRAINING

PREVENÇÃO DE LESÕES ARTICULARES DO JOELHO NO TREINO DOS ESPORTES DE INVERNO

PREVENCIÓN DE LAS LESIONES ARTICULARES DE LA RODILLA EN EL ENTRENAMIENTO DE LOS DEPORTES DE INVIERNO

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ABSTRACT

Introduction: With the 2022 Winter Olympic Games launch, ice and snow sports have come into the spotlight, receiving government incentives to encourage their practice. Objective: Examine the causes of knee injury in skiers, proposing preventive measures for joint injury. Methods: The current situation of joint injury in skiers' knees, joint movement in skiing, the cause of joint injury, and the prevention of joint injury were analyzed, and scientific prevention and corresponding treatment plan were developed according to the results of the analysis. Results: The injury rate among skiers is high. Ligament injury, tendon injury, and muscle strain are the three main types of injury. There are 57 mild injuries of various types to the knee joint - 53.27% of all injuries; 41 moderate injuries, representing 38.32% of all injuries; 9 serious injuries, representing 8.41% of all injuries, with minor injuries. Conclusion: This article examines knee motion and the causes of knee injury in skiers and proposes preventive measures for joint injury. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Snow Sports; Training Activities; Knee Injuries.

RESUMO

Introdução: Com o lançamento dos Jogos Olímpicos de Inverno de 2022, os esportes de gelo e neve entraram em evidência, recebendo incentivos governamentais para encorajamento de sua prática. Objetivo: Examinar as causas da lesão no joelho em esquiadores, propondo medidas preventivas para a lesão articular. Métodos: Foram analisadas a situação atual de lesão articular nos joelhos dos esquiadores, o movimento articular no esqui, a causa das lesões articulares e a prevenção de lesões articulares, além de um plano de prevenção científica e tratamento correspondente, de acordo com os resultados da análise. Resultados: A taxa de lesões em esquiadores é alta. Lesão ligamentar, lesão tendinosa e tensão muscular são os três principais tipos de lesão. Há 57 lesões leves de vários tipos na articulação do joelho - 53,27% de todas as lesões; 41 lesões moderadas, representando 38,32% de todas as lesões; 9 lesões graves, representando 8,41% de todos os ferimentos, com ferimentos menores. Conclusão: Este artigo examina o movimento do joelho e as causas da lesão no joelho em esquiadores, e propõe medidas preventivas para lesão articular. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Esportes na Neve; Atividades de Treinamento; Traumatismos do Joelho.*

RESUMEN

Introducción: Con la puesta en marcha de los Juegos Olímpicos de Invierno de 2022, los deportes de hielo y nieve han pasado a ser el centro de atención, recibiendo incentivos gubernamentales para fomentar su práctica. Objetivo: Examinar las causas de las lesiones de rodilla en los esquiadores, proponiendo medidas preventivas de las lesiones articulares. Métodos: Se analizó la situación actual de las lesiones articulares en las rodillas de los esquiadores, el movimiento articular en el esquí, la causa de las lesiones articulares y la prevención de las mismas, y se elaboró un plan científico de prevención y tratamiento correspondiente según los resultados del análisis. Resultados: El índice de lesiones en los esquiadores es alto. Las lesiones de ligamentos, las lesiones de tendones y las distensiones musculares son los tres tipos principales de lesiones. Hay 57 lesiones leves de diversos tipos en la articulación de la rodilla, el 53,27% de todas las lesiones; 41 lesiones moderadas, que representan el 38,32% de todas las lesiones; 9 lesiones graves, que representan el 8,41% de todas las lesiones, con lesiones leves. Conclusión: Este artículo examina el movimiento de la rodilla y las causas de las lesiones de rodilla en los esquiadores, y propone medidas preventivas para las lesiones articulares. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Deportes de Nieve; Técnica de Entrenamiento; Traumatismos de la Rodilla.*

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INTRODUCTION

On July 31, 2015, the 128th plenary session of the IOC was held in Kuala Lumpur. The conference announced that Beijing defeated its rival Almaty by 44 votes to 40 and won the right to host the 24th Winter Olympic Games in 2022. In the "Beijing 2022 Winter Olympics and Paralympic Games bid report" submitted by the Beijing Winter Olympics bid committee to the IOC, three visions were put forward. One of them was to light the torch for the all-round development of China's winter sports and promised to "encourage 300 million Chinese people to participate in ice and snow sports". After the goal was put forward, the government gave strong economic and political support and consolidated the mass foundation of ice and snow sports.

At present, the Winter Olympic Games are being held smoothly. Unlike the flat ground, skiing is another special and demanding sport. The speed of this sport is relatively fast, because the technical competitions such as slewing and great slewing, as well as the speed competition and super great slewing all put forward high requirements for the athletes' turning ability, and because the flexion, extension and swing of knee joint are the main actions of skiing, Therefore, for most athletes, the incidence of knee injury is very high.[1] A good skier should have good physical quality and special skills. The acquisition of these qualities and skills requires several or even more years of hard training. During this period, knee joint injuries often occur, disturbing the normal training and competition of athletes. Even if athletes continue training or competition under injury conditions, injury problems will shorten or even end athletes' sports career, affect athletes' career development, and cause huge waste of human, material and financial resources to the country.[2]

Therefore, this paper conducted a survey on Chinese skiers. Through the statistics and data analysis of the survey results, this paper preliminarily summarized the current situation of skiing injury and knee joint, and scientifically analyzed how to make skiers carry out better training and competition, so as to prevent the occurrence and development of knee joint injury.

METHOD

This is a research on sports injury, joint injury and joint injury prevention of athletes in ice and snow sports training. The collected data are analyzed by literature method, questionnaire survey method, logical analysis method, experimental method, and finally mathematical statistics method. The measurement data are selected and the prevention suggestions of joint injury are put forward, which makes a certain contribution to the joint injury of ice and snow athletes.

Questionnaire design: according to the research purpose of this paper, the questionnaire method is adopted. Through the deepening of the subject knowledge of "sports injury", according to the scientific theory and research purpose, a questionnaire on sports injury of skiers is compiled, which are "questionnaire on the characteristics of sports injury of skiers and prevention plan" and "questionnaire on the characteristics of sports injury of skiers and prevention plan", Experts in the field of sports injury are invited to evaluate the effectiveness of the questionnaire. The evaluation results show that the questionnaire is valuable.

Questionnaire distribution and recovery: as a part of the questionnaire collection process of the research on the characteristics of sports injury and the prevention and treatment of skiers, due to the needs of the paper and research, 125 questionnaires were distributed to athletes and recovered, with a recovery rate of 100%, 120 valid questionnaires and an effective rate of 96%. 50 questionnaires were distributed to coaches, 50 questionnaires were recovered, with a recovery rate of 100% and 50 valid questionnaires. The study and all the participants were reviewed and approved by Ethics Committee of Harbin Sport University (NO. 19HSUZ001).

Test requirements: the German isokinetic muscle monitor is used for the test. The athletes are tested according to the joint test of knee joint, and the test is carried out in strict accordance with the method specified by the instrument. In order to avoid large errors and muscle strain during the test, athletes should be prepared for 15 minutes before the test, so as to improve cardiopulmonary function and stretch the lower limb muscles as much as possible.

Test process: 1 Open the tool, measure the height, weight and main circumference of lower limbs of the tester, record the name, gender, age, training years and other basic information of the tester, and record it in the equipment. 2. Fix the corresponding knee and ankle joints. 3. Measure the index data of both knee joints at different speeds. Before each test, conduct three sub maximum prediction exercises, so that the tested athletes can be familiar with their isokinetic movement mode, so as to meet the requirements of instruments and master the essentials of movements. 4. At the end of the test, check the insufficient data and verify the data. The system automatically stores the original data, which is scaled to the computer processed and analyzed by the computer, and outputs the results through the printer.

RESULTS

Current situation of skiing injury 120 young athletes of a ski team in a province were investigated. The results showed that 115 athletes had sports injuries, accounting for 95.8% of the total number of athletes investigated, and only 5 athletes were not injured, accounting for 4.2%, indicating that the overall incidence of ski injuries is high. There are 75 male athletes in this survey. The results show that there are 73 injured athletes, with an injury rate of 97.3%, and only 2 uninjured athletes. In addition, 42 of the 45 female athletes who participated in the survey were injured, with an incidence of 93.3%. From the perspective of gender comparison, the injury frequency of male ski athletes is higher than that of female athletes. (Table 1)

The results show that the most common types of sports injuries in skiing are ligament strain, ligament rupture, muscle tendon strain, muscle strain, stress fracture, nervous system injury / concussion, contusion, frostbite, dislocation and scratch. Among them, ligament injury, tendon strain and muscle strain accounted for the top three, accounting for 80%, 76% and 68% respectively. This is because athletes are prone to imbalance during high-speed taxiing or high-frequency technical actions, resulting in skis deviating from the slide, skis interlacing or too large separation angle, resulting in ligament damage and tendon strain. Subsequently, 56% were contusion, 32% were frostbite, 28% were nervous system / concussion, 24% were stress fractures and 16% were ligament fractures.

By investigating the number of sports injuries in different body parts of skiers, the results show that the ski injury parts include head, neck, back, chest, ribs, sacrum, shoulder, elbow, forearm, wrist, knee, hip, lower leg, ankle and foot. The injury rates of waist and knee are the highest, accounting for 14.81% and 15.56% respectively. Shoulder and thigh account for 9.63% and 11.11% respectively, The head accounts for 5.19%, the neck for 5.93%, the chest for 1.48%, the ribs for 2.22%, the sacrum for 3.70%, the elbow for 3.70%, the forearm for 2.96%, the wrist for 8.15%, the hip for 2.22%, the lower leg for 4.44%, and the ankles and feet for 5.19%. (Table 2)

It can be seen from table 2 that knee joint injury is the most common injury part in skiing. Therefore, this paper takes this as the starting point to analyze knee joint injury in skiing.

Table 1. Statistics of incidence rate of sports injuries among men and women (n=120).

Group	Number	Injuries	Percentage (%)
Male athlete	75	73	97.3%
Female athlete	45	42	93.3%
Total	120	115	95.8%

Current situation of ski knee injury

According to the severity of injury, sports injury can be divided into the following three categories: minor injury, moderate injury and serious injury. Minor injury refers to the injury can still be trained according to the coach's training plan, which will affect physical activities within 24-48 hours, and can be cured after general treatment; Moderate injury refers to the inability to carry out planned training after injury, which affects the body's activities within 1 ~ 2 weeks, and can resume normal activities after routine treatment and short-term rehabilitation training; Serious injury refers to the loss of exercise ability after injury, which affects physical activity for more than 2 weeks after injury. Fracture and meniscus tear injury are serious injuries, which require special treatment and long rehabilitation training to resume normal exercise.

According to statistics, 56 Chinese Skiers suffered minor knee injuries, accounting for 52.34% of all injuries; There were 42 cases of moderate injury, accounting for 39.25% of all injuries; A total of 9 people were seriously injured, accounting for 8.41% of all injuries, as shown in Figure 1.

Based on the investigation and analysis of the knee injury of 21 male ski athletes, 13 of them were slightly injured, accounting for 61.9% of the total number of athletes; Five of them reported moderate injuries, accounting for 23.8% of the total number of athletes; Three people were seriously injured, accounting for 14.3% of the total number of athletes; 0 people were not injured. It can be seen that the knee sports injury of most skiers is mild to moderate, as shown in Figure 2.

The survey found that among 21 male skiers with knee injury, 14 were injured in pre competition training, accounting for 66.7% of the total number of injuries; Two people were injured in the competition, accounting for 9.5% of the total; Three people were injured in the preparation period, accounting for 14.3% of the total number of injuries; 2 people were injured during the post-match adjustment period, accounting for 9.5% of the total number of injuries, as shown in Table 3.

The peak torque data of constant speed flexion and extension of the knee joint of skiers are shown in Table 4.

Table 2. Statistics of sports injury parts.

	Injury	Number of injuries	Percentage
Trunk	head	7	5.19%
	neck	8	5.93%
	Waist back	20	14.81%
	chest	2	1.48%
	rib cage	3	2.22%
	Tibia	5	3.70%
Upper limbs	shoulder	13	9.63%
	elbow	5	3.70%
	forearm	4	2.96%
	wrist	11	8.15%
Lower extremity	thigh	15	11.11%
	knee	21	15.56%
	Hip	3	2.22%
	Calf	6	4.44%
	ankle	7	5.19%
	foot	5	3.70%
Total	--	135	100%

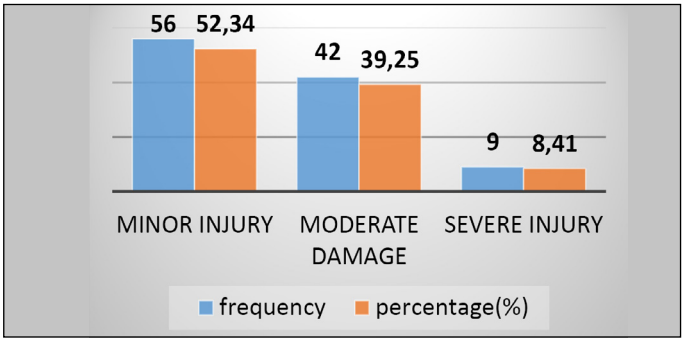

Figure 1. Degree and times of sports injury of ski athletes' knee joint.

DISCUSSION

From the perspective of sports physiology, the muscle types of skiers are mixed, mainly slow muscles, to meet the needs of aerobic and anaerobic metabolism during competition. Skiers have better leg strength than other athletes. Good leg strength, especially quadriceps and hamstrings, is the guarantee for skiers to achieve good results.[3] In addition, top athletes have strong centrifugal rather than centripetal muscle contraction skills, and the strength of knee extensor can ensure that athletes can complete centrifugal contraction slowly and effectively during rotation. Moreover, because skiing is an alpine competition, athletes often experience some Alpine physiological changes. Athletes may have low-pressure hypoxia, such as increased red blood cell volume, increased hemoglobin and increased blood cell volume, so as to ensure sufficient iron content. When this balance is insufficient (for example, insufficient iron reserves and anemia), training and competition performance will be affected.[4]

Strictly abide by the training principles in the training plan, reasonably organize the training workload, pay attention to the fatigue

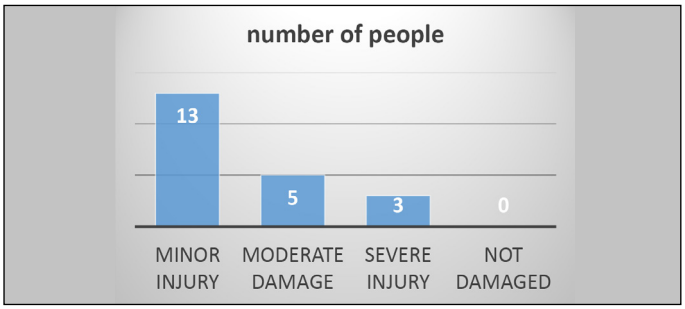

Figure 2. Number of ski athletes with knee injury.

Table 3. Statistical table of time characteristics of knee joint sports injury of male ski athletes.

Period	Front training period	Game period	Prepare period	Adjustment period after the game	Total
Number of people	14	2	3	2	21
Percentage (%)	66.7	9.5	14.3	9.5	100.00

Table 4. List of peak moment of isokinetic knee flexion and extension of skiers.

Angular speed	Left			Right		
	60° /s	120° /s	180° /s	60° /s	120° /s	180°/s
Draft muscle peak moment (Nm)	90.58±20.76	85.67±20.48	73.26±18.85	93.22±16.5	89.53±22.02	72.59±15.1
Draft muscle relative peak moment (Nm / kg)	1.51±0.26	1.41 ±0.32	1.17±0.26	1.47±0.16	1.43±0.34	1.19±0.26
Stretch muscle peak power distance (Nm)	183.15±49.74	162.46±29.94	119.79±33.45	178.52 ±34.62	167.31±20.78	120.2±20.7
Extension muscle relative peak moment (Nm / kg)	2.91±0.7	2.70±0.47	1.92±0.46	2.84±0.34	2.60 ±0.38	1.89±0.22
Peak retrorealum / stretch (%)	0.49±0.08	0.57±0.21	0.63±0.21	0.53±0.12	0.57±0.17	0.60 ±0.14

and recovery of athletes, avoid local overload of knee joint, and follow the principle of step-by-step in the training process. Don't train in the state of fatigue. At this time, athletes react slowly and move uncoordinated, which is easy to cause injury. Coaches should strictly follow the principle of step-by-step, design the basic trend of load measurement change, scientifically plan and effectively adjust the load and intensity change. And the arrangement of load measurement should adapt to the periodic changes of athletes' physical conditions. The load change within a reasonable range can promote the improvement of athletes' physical function and competitiveness. Coaches and athletes should also pay attention to the recovery after sports, and use a variety of recovery methods such as sports science, medical biology, nutrition and psychology to eliminate the fatigue caused by sports load in time, which can prevent the occurrence of injury.[5]

CONCLUSION

China's skiing projects are still in the stage of development, from teaching and training to scientific research, and are still in the stage of introduction, learning and exploration. Therefore, based on the literature, this paper analyzes the current situation of injury in the process of skiing training, the causes of joint injury, knee movement and joint injury, and puts forward relevant measures to prevent joint injury. It is hoped that coaches, scientific researchers and medical supervisors will coordinate and cooperate to study the prevention of joint injury. Improve the training efficiency of skiers, reduce athletes' injuries and make a contribution to China's skiing projects.

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