

# INFLUENCE OF SPORTS INJURIES AND RESISTANCE TRAINING ON SKIERS' BONE MASS



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INFLUÊNCIA DE LESÕES ESPORTIVAS E TREINAMENTO DE RESISTÊNCIA NA MASSA ÓSSEA DE ESQUIADORES

INFLUENCIA DE LAS LESIONES DEPORTIVAS Y DEL ENTRENAMIENTO DE RESISTENCIA EN LA MASA ÓSEA DE LOS ESQUIADORES

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## ABSTRACT

**Introduction:** With the preparation and development of the Winter Olympic Games, there has been an increase in the popularity of skiing. Driven by this demand, the professional development of coaches requires updates in the analysis of skiers' sports injuries, elaboration of corresponding prevention and treatment strategies, and resistance training to promote the development of athletes' physical quality, such as bone mass and mineral density. **Objective:** Study the sports injuries of skiers and explore needs and ways of applying resistance training in skiing. **Methods:** The questionnaire survey was used to explore the main types of injuries and their influencing factors. Then, 20 volunteers were selected for the resistance training experiment; each group of 10 people included five men and five women. The control group maintained a normal daily life, while resistance training was added to the experimental group three times a week, based on the control group. **Results:** The research results showed that the current proportion of skiing injuries was relatively high, mainly in mild injuries. After nine weeks in the experimental resistance training group, both men and women had positive bone mass development. **Conclusion:** Resistance training can improve physical quality and reduce the occurrence of sports injuries, demonstrating the benefits of its implementation in endurance training for skiers. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

**Keywords:** Athletic Injuries; Endurance Training; Bone Density.

## RESUMO

**Introdução:** Com a preparação e desenvolvimento dos Jogos Olímpicos de Inverno, houve um aumento da popularidade do esqui. Impulsionados por essa demanda, o desenvolvimento profissional dos treinadores requer atualizações nas análises de lesões esportivas dos esquiadores, elaboração de estratégias de prevenção e tratamento correspondentes, além de treinamentos de resistência de modo a promover o desenvolvimento da qualidade física dos atletas, como a massa óssea e sua densidade mineral. **Objetivo:** Estudar as lesões esportivas dos esquiadores e explorar necessidades e modos de aplicação do treino de resistência no esqui. **Métodos:** O método de pesquisa por questionário foi utilizado para explorar os principais tipos de lesões e seus fatores influenciadores. Em seguida, 20 voluntários foram selecionados para o experimento de treinamento de resistência, cada grupo de 10 pessoas incluiu 5 homens e 5 mulheres. O grupo controle manteve uma vida diária normal, enquanto ao grupo experimental foi adicionado um treinamento de resistência, três vezes por semana, com base no grupo controle. **Resultados:** Os resultados da pesquisa mostraram que a proporção atual de lesões por esqui foi relativamente alta, principalmente em lesões leves. Após 9 semanas no grupo experimental de treinamento de resistência, tanto homens quanto mulheres tiveram desenvolvimento positivo de massa óssea. **Conclusão:** O treinamento de resistência pode não só melhorar a qualidade física, mas também reduzir a ocorrência de lesões esportivas, demonstrando os benefícios de sua implementação no treinamento de resistência dos esquiadores. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

**Descritores:** Traumatismos em Atletas; Treinamento de Resistência; Densidade Óssea.

## RESUMEN

**Introducción:** Con la preparación y el desarrollo de los Juegos Olímpicos de Invierno, ha aumentado la popularidad del esquí. Impulsado por esta demanda, el desarrollo profesional de los entrenadores requiere actualizaciones en el análisis de las lesiones deportivas de los esquiadores, la elaboración de las correspondientes estrategias de prevención y tratamiento, así como el entrenamiento de la resistencia para promover el desarrollo de la calidad física de los atletas, como la masa ósea y la densidad mineral. **Objetivo:** Estudiar las lesiones deportivas de los esquiadores y explorar las necesidades y formas de aplicar el entrenamiento de resistencia en el esquí. **Métodos:** Se utilizó el método de encuesta por cuestionario para explorar los principales tipos de lesiones y sus factores de influencia. A continuación, se seleccionaron 20 voluntarios para el experimento de entrenamiento de resistencia, cada grupo de 10 personas incluía 5 hombres y 5 mujeres. El grupo de control mantuvo una vida diaria normal, mientras que al grupo experimental se le añadió un entrenamiento de resistencia, tres veces por semana, basado en el grupo de control. **Resultados:** Los resultados de la



investigación mostraron que la proporción actual de lesiones de esquí era relativamente alta, principalmente en las lesiones leves. Después de 9 semanas en el grupo experimental de entrenamiento de resistencia, tanto los hombres como las mujeres tuvieron un desarrollo positivo de la masa ósea. Conclusión: El entrenamiento de resistencia no sólo puede mejorar la calidad física, sino también reducir la aparición de lesiones deportivas, lo que demuestra los beneficios de su aplicación en el entrenamiento de resistencia de los esquiadores. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.**

**Descriptores:** Traumatismos en Atletas; Entrenamiento Aeróbico; Densidad Ósea.

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## INTRODUCTION

With the preparation and progress of the Winter Olympics, skiing has gained a good opportunity for development. Driven by this opportunity, we should timely analyze the sports injuries of skiers, put forward corresponding prevention and treatment strategies, and carry out certain endurance training for trainers, so as to promote the more professional development of trainers. It also provides some help for the development of their own physical quality, such as bone mass and bone mineral density. Through various promotion, we can not only strengthen the physical fitness of ski lovers and achieve the goal of rejuvenating the country through sports, but also eliminate the scruples of potential target groups about skiing and further promote skiing, but also promote the progress of the environment and medical facilities of skiing places, so as to reduce problems as much as possible and prevent security loopholes. Really promote the development of skiing in China.<sup>1</sup>

Skiing is divided into two parts: land sports and snow sports. Skiers who choose systematic training often combine the two sports, so as to further improve their sports skills and improve their sports level. The literature suggests that land training is more about the training of skills, and the injuries are less and mostly concentrated in the lower limbs. The injuries of the upper limbs increase significantly during snow training. On the whole, the injuries of skiing are mainly concentrated in the waist, knee and ankle, and the main types of injuries are strain, sprain, contusion and so on.<sup>2</sup> Literature research shows that in skiing, both beginners and experienced skiers will have injuries, but relatively speaking, the severity of the injury is not high, and the cause of the injury is often caused by tension or unskilled movement skills. In addition, some skiing lovers often choose relatively dangerous places for sports due to their pursuit of stimulation. The skill level of these athletes is relatively high, but once sports injury occurs, the consequences are also more serious. Through the study of literature, this paper selects ordinary skiing enthusiasts, who account for the largest proportion in the current skiing market, as the object of research and analysis, analyzes their skiing injury and carries out certain endurance training, so as to study the current skiing injury and the impact of systematic training on the physical quality and skill development of skiing enthusiasts, So as to ensure the safe and stable development of the ski market and promote the progress of the ski industry in China.<sup>3,4</sup>

## METHOD

Firstly, through the literature research method, this paper consulted a large number of books and literature, analyzed the current situation of skiing in China, selected and analyzed from three aspects: athletes, extreme skiing enthusiasts and ordinary skiing enthusiasts, and finally selected ordinary skiing enthusiasts as the research object. Then, through the interview method, we interviewed professional ski coaches, ski resort coaches, relevant sports experts, ski club managers and relevant medical workers to fully understand the current damage of ordinary skiing and the relevant coping strategies of ski resorts, and consult experts for their opinions.

On the basis of accumulating some experience, this paper uses the questionnaire survey method to obtain the relevant information of 490

ski enthusiasts through voluntary registration, and analyzes the injury situation, injury type, injury scene, injury factors and so on, so as to further understand the sports injury of skiing. Then, using the experimental method, the volunteers were given some endurance training, and the bone mass characteristics before and after training were analyzed, so as to analyze the impact of endurance training of skiing.

Twenty skiing beginners were selected and divided into 10 experimental groups and 10 control groups. Each group includes 5 men and 5 women. The study and all the participants were reviewed and approved by Ethics Committee of Northeast Agricultural University (NO. 20194453). The diet of the control group and the experimental group is the same every day, and the daily exercise intensity remains the same through calculation. The control group does not arrange additional training. The experimental group carries out endurance training three times a week, including walking imitation. The whole experimental research cycle is 9 weeks. Before and after the experiment, the factors of bone mineral density are sorted and analyzed to explore the difference of bone mineral density before and after the experiment, so as to analyze the influence of endurance training on bone mass.

## RESULTS

### Analysis of sports injury of skiers

As shown in Table 1, through the analysis of 490 skiing enthusiasts' injuries, it can be seen that among 274 male skiing enthusiasts, 81 were injured, with an injury rate of 29.56%, and among 216 female sports enthusiasts, 53 were injured, with an injury rate of 24.54% and an overall injury rate of 27.35%, indicating that the injuries of skiing are relatively high compared with other sports, And the injury rate of men is slightly higher than that of women, which also proves the importance of safety protection of skiing.

### Analysis of influencing factors of sports injury of skiers

In order to analyze the influencing factors of skiing enthusiasts' injury, so as to carry out corresponding rectification, this paper analyzes the scene of skiing enthusiasts' injury and its main factors.

As shown in Table 2, in the analysis of the main influencing factors (single choice) of skiers' sports injury, we can find that 31.34% of people

**Table 1.** Injury rate of 490 skiers with sports injuries.

Option	Number of surveys	Number of injuries	Injury rate
Male	274	81	29.56%
Female	216	53	24.54%
Total	490	134	27.35%

**Table 2.** Main causes of sports injury of skiers.

Influencing factors	Number	Percentage
Physical strength	42	31.34%
No good novice mode	21	15.67%
Cognitive and behavior deviation	11	8.21%
Can't concentrate attention	17	12.69%
Not suitable for venues	27	20.15%
Sports skills are not skilled	16	11.94%

think that the influencing factor is physical weakness, and they often have sports injury caused by physical weakness in the second half of skiing; The main factor affecting the injury of 20.15% of athletes is the maladjustment to the site, which is often caused by the sports injury during the exploration of new sites; 15.67% of skiers believed that the main influencing factor of their sports injury was the improper design of sports mode in the ski resort, which could not provide better novice sports mode for beginners. In addition, the lack of complete concentration, the inability to master appropriate skills and the deviation between their brain cognition and physical behavior are also considered to be the main influencing factors. These problems are worth thinking by the ski resort management and the ski athletes themselves.

The average scores are sorted and collected. The results are shown in Table 3. It can be seen that the three most important injury factors considered by ski enthusiasts, from large to small, are challenging difficult movements, not fully familiar with the site and excessive exercise intensity, followed by insufficient preparation activities and unskilled sports skills, while the importance score of the limitations of ski materials and the influence of weather conditions is relatively low.

Through the investigation and Research on the sports injuries of skiers, it can be seen that there are no too many differences between men and women in the current skiing sports injuries. Relatively speaking, the proportion of injuries for beginners is high and most of them are minor injuries. The main reasons are that they are not familiar with the venue and sports skills, and they fail to have a full understanding of their physical strength, resulting in excessive sports intensity, Lack of physical strength; The reason for the injury of experienced ski enthusiasts is often that they want to challenge difficult movements and insufficient preparation activities. The proportion of injury is relatively low, but it does not rule out the serious injury caused by the pursuit of limits.

### Results of bone mass changes after endurance training

This paper measured the changes of bone mineral density before and after endurance training, as shown in Table 4 and table 5.

As shown in Table 4, the BMD indexes of female subjects before and after endurance training were compared. Through the comparative analysis of ultrasonic amplitude, ultrasonic sound velocity and bone mineral content, it can be seen that the big data of the control group had little change before and after endurance training, and there was no statistical difference. The ultrasonic amplitude, ultrasonic velocity and bone mineral content of the experimental group were increased, and there were statistically significant differences ( $P < 0.05$ ).

As shown in Table 5, it can be seen that the bone mineral density of male subjects increased in ultrasonic speed and bone mineral content before and after endurance training, but the increase was relatively low compared with women, and the ultrasonic amplitude showed a slight decrease, which was statistically significant ( $P < 0.05$ ).

It can be seen that the change range of bone mineral density index of male subjects before and after endurance training experiment is lower than that of women. Combined with the training methods of endurance training, it can be seen that there are certain differences in daily physical

**Table 3.** Importance score of influencing factors of sports injury of skiers.

Training factor	Important degree average
Preparation is not sufficient	3.56
Excessive exercise intensity	3.74
Challenge high difficult movements	3.93
Sports skills are not skilled	3.26
Not familiar with the venue	3.76
Ski equipment limitations	2.51
Weather conditions	2.89

**Table 4.** Comparison of bone mineral density indexes of female subjects before and after the experiment (mean  $\pm$  standard deviation).

Type		Test group (n=5)	Control group (n=5)
Ultrasound amplitude (dB / MHz)	Before	78.536 $\pm$ 11.341	78.421 $\pm$ 12.43
	After	81.258 $\pm$ 10.657	76.748 $\pm$ 14.29
Ultrasound speed (m/s)	Before	1516.523 $\pm$ 15.764	1534.476 $\pm$ 23.13
	After	1524.962 $\pm$ 16.745	1532.468 $\pm$ 18.06
Bone mineral content (kg)	Before	2.542 $\pm$ 0.363	2.243 $\pm$ 0.287
	After	2.564 $\pm$ 0.347	2.294 $\pm$ 0.321
OSI	Before	2.101 $\pm$ 0.019	2.841 $\pm$ 0.287
	After	2.581 $\pm$ 0.327	2.214 $\pm$ 0.297
Z	Before	0.756 $\pm$ 0.684	1.086 $\pm$ 1.389
	After	0.999 $\pm$ 1.012	0.988 $\pm$ 0.884
T	Before	0.029 $\pm$ 0.428	0.274 $\pm$ 1.352
	After	0.241 $\pm$ 0.653	0.068 $\pm$ 0.991

**Table 5.** Comparison of bone mineral density indexes of male subjects before and after exercise (mean  $\pm$  standard deviation).

Type		Test group (n=5)	Control group (n=5)
Ultrasound amplitude (dB / MHz)	Before	82.892 $\pm$ 14.597	89.398 $\pm$ 13.597
	After	80.857 $\pm$ 12.689	81.288 $\pm$ 11.182
Ultrasound speed (m/s)	Before	1533.321 $\pm$ 21.637	1532.137 $\pm$ 30.115
	After	1535.541 $\pm$ 18.889	1537.123 $\pm$ 21.789
Bone mineral content (kg)	Before	2.921 $\pm$ 0.279	2.894 $\pm$ 0.274
	After	3.035 $\pm$ 0.198	3.089 $\pm$ 0.217
OSI	Before	2.874 $\pm$ 0.238	2.897 $\pm$ 0.239
	After	2.822 $\pm$ 0.184	2.827 $\pm$ 0.249
Z	Before	0.389 $\pm$ 0.9297	0.564 $\pm$ 0.848
	After	0.219 $\pm$ 0.6783	0.289 $\pm$ 0.843
T	Before	-0.108 $\pm$ 0.838	-0.021 $\pm$ 0.765
	After	-0.247 $\pm$ 0.609	-0.257 $\pm$ 0.794

strength between men and women, Therefore, for men, the difference between the same amount of exercise and the amount of exercise in daily life is far less than that of women. In short, men are more suitable for the current endurance training program than women, so the change range of men is less than that of women. Overall, endurance training can effectively improve the bone mass of athletes, promote the benign development of bones, reduce osteoporosis and other problems, and is conducive to the improvement of athletes' physique.

### DISCUSSION

Through the analysis of the previous article, it can be seen that the great reason for the sports injury of skiing enthusiasts, especially beginners, is the lack of physical strength, and strengthening endurance training can effectively prevent the sports injury caused by lack of physical strength. For ski resorts, the new training mode should include endurance training, so as to cultivate good sports skills from novices and reduce sports injuries caused by unskilled skills or insufficient endurance. By studying the current development of ordinary skiing and combined with the training mode of professional skiers, this paper puts forward a sports endurance training method suitable for commercial ski resorts.<sup>5</sup>

After having a certain understanding of skiing technical movements and improving their basic aerobic endurance, skiing enthusiasts can carry out snow training in the primary ski track. The goal of this stage is to combine the accumulated content of land training with the actual snow environment, so as to cultivate the adaptability of training, so that beginners can integrate and apply the learned knowledge on the basis of adapting to the characteristics of snow sports, and get familiar with the snow track and snow skiing equipment as soon as possible. This stage is not only the adaptation of movement, but also the adaptation of

psychology. Strengthen the cooperation between cognition and body, eliminate the tension of skiing psychologically, and enjoy sports. In the novice area, coaches should evaluate the endurance of beginners, make beginners aware of their endurance, effectively select the appropriate exercise intensity and duration, and carry out certain special training to enhance the development of speed endurance and aerobic endurance, so as to improve the skills and endurance of beginners.<sup>6</sup>

## CONCLUSION

With the preparation and holding of the Winter Olympic Games in full swing, skiing has a greater national degree and attracts more potential people. Through the analysis of skiing sports injury, it can be found that the lack of strength of skiers is an important factor leading to sports injury. Therefore, systematic endurance training for skiers can effectively improve the level of skiers' endurance and make them have a deeper understanding of their own endurance, so as to reduce the

sports injury in the process of skiing. Therefore, in the process of promoting skiing, we must pay attention to the prevention of skiing injury, strengthen endurance training and technical training, and provide more systematic training for skiing lovers step by step, so that skiers can not only enjoy the joy of sports, reduce pressure, but also achieve strong physique, enhance muscle strength and bone quality, so as to promote the development of national sports and national sports.

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