MODEL FOR PREVENTING TISSUE INJURY IN THE PROCESS OF ATHLETE TRAINING

MODELO PARA PREVENÇÃO DE LESÕES TECIDUAIS NO PROCESSO DE TREINAMENTO DE ATLETAS

MODELO PARA PREVENCIÓN DE LESIONES TISULARES EN EL PROCESO DE ENTRENAMIENTO DE ATLETAS

ORIGINAL ARTICLE
ARTIGO ORIGINAL
ARTÍCULO ORIGINAL

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ABSTRACT

Introduction: The topic of preventing tissue damage during sports is a heavily debated one. Uncovering factors related to sports injuries is essential to deal with this issue. Objective: To analyze the causes of athletes' sports injuries, providing a theoretical basis for reducing the occurrence of sports injuries and increasing the success rate of athletes. Methods: This article uses statistical methods to investigate and analyze the causes of athletes' sports injuries. Results: Four important factors lead to athletes' sports injuries: poor physical fitness, inadequate warm-up activities, incorrect techniques, and excessive loads. Conclusion: Coaches should systematically prepare multi-year training plans, step by step, and pay attention to long-term effects. This is the only way athletes can achieve their best performance at the appropriate age. ***Level of evidence II; Therapeutic studies - investigation of treatment results.***

Keywords: Athletes; Athletic injuries; Sports.

RESUMO

Introdução: A prevenção de danos teciduais durante a prática esportiva é um tópico acaloradamente debatido. Descobrir os fatores relacionados a ferimentos esportivos é essencial para lidar com esse agravo. Objetivo: Analisar as causas dos ferimentos esportivos em atletas, fornecendo uma base teórica para reduzir o número de ferimentos esportivos e aumentar a taxa de sucesso de atletas. Métodos: Esse artigo usa métodos estatísticos para investigar e analisar a causa das lesões esportivas em atletas. Resultados: Quatro fatores importantes levam às lesões esportivas dos atletas: preparo físico ruim, aquecimento inadequado, técnica incorreta e cargas excessivas. Conclusão: Técnicos deveriam preparar, passo-a-passo, treinamentos sistemáticos com duração de vários anos, levando em consideração seus efeitos de longo prazo. Só assim atletas podem atingir sua melhor performance na idade adequada ***Nível de evidência II; Estudos terapêuticos – investigação de resultados de tratamento.***

Descritores: *Atletas; Traumatismos em atletas; Esportes.*

RESUMEN

Introducción: La prevención de daños tisulares durante la práctica deportiva es un tópico muy debatido. Descubrir los factores relacionados con las lesiones deportivas es esencial para lidiar con este problema. Objetivo: Analizar las causas de las lesiones deportivas en atletas, suministrando una base teórica para reducir el número de lesiones deportivas y aumentar la tasa de éxito de atletas. Métodos: Este artículo usa métodos estadísticos para investigar y analizar la causa de las lesiones deportivas en atletas. Resultados: Cuatro factores importantes ocasionan las lesiones deportivas de los atletas: preparación física insuficiente, calentamiento inadecuado, técnica incorrecta y cargas excesivas. Conclusión: Técnicos deberían preparar, paso a paso, entrenamientos sistemáticos con duración de varios años, teniendo en cuenta sus efectos a largo plazo. Solo así los atletas podrían alcanzar su mejor desempeño en la edad adecuada. ***Nivel de evidencia II; Estudios terapéuticos – investigación de resultados de tratamiento.***

Descriptores: *Atletas; Traumatismos en atletas; Deportes.*

DOI: http://dx.doi.org/10.1590/1517-8692202228022021_0424 Article received on 11/01/2021 accepted on 12/23/2021

INTRODUCTION

Modern rhythmic gymnastics is constantly developing towards serious difficulty, novelty, grace, and harmony. This has continuously improved the physical and psychological requirements of athletes.[1] Therefore, the probability of athletes having sports injuries is correspondingly increased. This article is based on a survey of Chinese juvenile athletes and coaches. This article aims to study the training causes of juvenile rhythmic gymnastics injuries in China. This provides a theoretical basis for reducing the occurrence of sports injuries and increasing the success rate of athletes.

METHOD

Research object

Fifty-four players will participate in the 2020 National Junior Rhythmic Gymnastics Championships. Eight players are participating in the 2020 National Rhythmic Gymnastics Championship.[2] The players are 9-13 years old, with an average age of 10.8 years.

Research methods

Seventy questionnaires were distributed to athletes, and 62 were recovered. The recovery rate was 88.6%. Thirty-six questionnaires for

coaches were distributed, and 36 were recovered, with a recovery rate of 100%. We use factor analysis to analyze the main causes of training.

Optimization simulation of sports injury relationship

α_1 represents the joint parts of the body that are prone to damage during high-intensity training. $K(\cdot)$ represents the athlete's systolic blood pressure and maximum heart rate before training.[3] Then use the following formula to calculate the damage rate of each item type in training

$$\min\{F_C(X) = \frac{\sum_{i=1}^{n} d_{cij}(x_{ij})}{K(\cdot)\times\alpha_i} \quad (1)$$

x_{ij} represents the nature of the athlete's injury during training. d_{cij} resistance represents the nature of sports injuries in different sports. n represents the number of vulnerable parts. S' represents the training item that has the least impact on the injury. u represents the per capita injury rate of athletes in high-intensity training. p_t represents the injury characteristics of athletes in different events in high-intensity training, and the following formula is used to obtain all the factors that cause athletes' injury in high-intensity training

$$T_{\square} = \frac{F_c(X)\cdot S'}{u\times X_{ijk}\cdot p_t}\cdot A_{ijk} \quad (2)$$

A_{ijk} Rong represents the various causes of sports injuries. X_{ijk} represents the percentage of each type of sports injury. $F_c(X)$ represents the athlete's injury law. Use the following formula to build a model of the relationship between high-intensity training and sports injury

$$J_{\xi} = \frac{\min\{F_c(X)}{T\times A_{ijk}}\otimes T_0 \quad (3)$$

T_o represents the injury rate of each joint of the athlete.

RESULTS

Questionnaire on Causes of Sports Injuries of Juvenile Rhythmic Gymnasts. The table lists 22 training factors that cause injuries. According to their importance, thirty-six coaches are asked to score 4, 2, and 1 points for the 22 training factors.[4] We used SPSS software to perform factor analysis on the scores of 22 injury factors in the coaches questionnaire. The characteristic value is greater than 1, and the cumulative contribution rate is 74.1%. Concerning the questionnaire results on the causes of juvenile athletes' sports injuries, this article analyzes the first four important factors.

Poor physical fitness

This indicator has the highest score for the injury factor in the coaches' questionnaire. It accounted for 16.32% of the total injury factors in the athlete questionnaire and ranked first. This shows that Chinese rhythmic gymnastics coaches and young athletes believe that poor physical fitness is the most important factor causing sports injuries.[5] Physical fitness is divided into general physical fitness and special physical fitness. Comprehensive and solid physical fitness is the prerequisite for the development of special sports skills.

The specific physical fitness of rhythmic gymnastics mainly includes strength, balance, flexibility, endurance, speed, coordination, etc. (Table 1). It can be seen from the table that most of the coaches in China mainly emphasize flexibility, coordination, and jumping ability training at the basic training stage but ignore the training of strength and endurance qualities.[6] Among the sports injuries caused by physical fitness, injuries caused by poor endurance quality accounted for 12.86%, and injuries caused by poor strength quality accounted for 58.57% (Table 2). This is enough to prove that Chinese juvenile rhythmic gymnastics coaches did not pay enough attention to the training of strength quality, which increased the probability of sports injuries. Good physical fitness can reduce the probability of young athletes' sports injuries and help prevent repetitive injuries.

Table 1. The importance of coaches' awareness of physical fitness.

Content	Order	%
Flexible	1	93
Coordination	2	80
Bounce	3	90
Dexterity	4	98
Speed	5	86
Strength	6	65
Endurance	7	86

Table 2. Percentage of sports injuries caused by poor physical fitness of young athletes.

Content	Strength	Flexible	Endurance	Coordination	Total
Order	1	2	3	4	
%	58.57	21.43	12.86	7.14	100

Unreasonable preparation activities

Sports injuries caused by unreasonable factors in warm-up activities rank second in the total injury factors. The warm-up activity is one of the three major components of the training class, and it is of great significance to the training class. Warm-up is to improve the excitability of the central nervous system through low-to-medium-intensity exercise to make it reach an appropriate level. This can strengthen the activities of various organs and overcome various functional inertia, increase the temperature and functional flexibility of muscles and tissues, strengthen the conditioned reflex connection, and promote the human body to turn into a working state quickly.[7] It is one of the important measures to prevent sports injuries. Rhythmic gymnastics belongs to the category of difficult and beautiful skills, and the technical movements have the characteristics of serious difficulty and complexity. If the warm-up activity is unreasonable, the probability of sports injuries will increase.

Incorrect technical essentials

Incorrect technical essentials refer to athletes due to technical shortcomings and errors. It violates the characteristics of the human body structure, the activity law of various organ systems, and the mechanical principles during exercise, which cause body tissue damage. The questionnaire for coaches ranks second in the scores of the athletes' sports injury factor questionnaire. Correct and reasonable technology is the best combination of the elements of biomechanics principles. It can not only complete difficult movements gracefully and lightly but also prevent sports injuries. Wrong technical essentials violate the structural characteristics of the human body, the law of activity of various organ systems, and the mechanic's principles during exercise, which can easily cause sports injuries.

Partially overburdened

Partial overburden refers to the unscientific arrangement of coaches' training content and sports training load during training, which causes the athlete's local training load to exceed the physical burden he may bear and cause sports injuries.

Sports training load is the most active factor in sports training activities, and it carries out training from beginning to end. One of the important tasks of a coach is to research and determine to achieve specific training goals.[8] How many loads an athlete can and should bear, and how to bear this load. The gradual increase in exercise load is one of the important reasons for the continuous improvement of competition. But the ability of any object to bear load or stimulation has certain limits. The training practice of many elite athletes shows that the greater the exercise load, the better. In particular, the load of young children in the basic training stage is the bigger, the better, but attention should be paid to avoid excessive local load during training. When the human body is over-loaded, not only will the body not be adaptable, but it will also have a deteriorating reaction. Partial overload will also cause deterioration, seriously damaging the normal training and the athlete's health.

DISCUSSION

We can see that difficult movements have become popular from the development of modern rhythmic gymnastics and the 2020 new international rules. Ultra-high difficulty and continuous innovation of technical movements are the development trend of modern rhythmic gymnastics. Sports practice shows that the more difficult the technical action, the more advanced the technology, the higher the athlete's physical fitness. When mastering a super-difficult movement or learning an advanced technique, you must first have the physical qualities required by these techniques. It is a prerequisite for excellent results. When athletes do not have the necessary physical fitness but begin to learn difficult movements, their physical ability levels are lower than the technical ability requirements. Due to poor muscle strength and elasticity, insufficient flexibility and stability of the joints, and slow response, it is easy to cause sports injuries to young athletes. This will affect the athletes' success and leave hidden dangers in sports training for many years in the future.

Insufficient warm-up activity means that the activity performed by the athlete does not fully mobilize the organ systems involved in training, and the body does not reach the appropriate level. At this time, the temperature of the muscles is low, the elasticity is poor, and the body lacks coordination. Because athletes do not fully understand the physiological effects of warm-up activities and are perfunctory, injury accidents are extremely likely to occur.

Excessive warm-up activity means that the exercise load borne by the athlete in the warm-up exercise exceeds the appropriate load. When the athlete enters the formal training competition, the body function has declined or is fatigued. In this case, muscle and ligament strains and sprains are prone to occur.

The unprepared activity means that the athlete directly enters the basic part of the training class and directly bears the exercise load of the basic content. When the nervous system and other organ systems are not prepared for the function of the nervous system, they are prone to muscle strain and joint ligament sprain. This is because the muscle strength and the stretchability of ligaments are not enough, and the coordination of the body is poor.

Therefore, in training, the coach should make the athletes make adequate preparations. Athletes are prepared physically and psychologically for the upcoming training tasks. The number of warm-up activities should be determined according to the individual's functional status, climatic conditions, teaching and training content, and load. Warm-up activities are generally based on body warming, slight sweating, and no fatigue. The time interval between the warm-up activity and the formal training competition is usually 1-4 minutes.

The overall response to excessive load in rhythmic gymnastics is not obvious. In the training of young rhythmic gymnasts in China, some coaches do not pay attention to arranging the amount of exercise according to the athletes' physical characteristics but are eager for success. The special training they developed was the too hasty and one-sided pursuit of the difficulty of the action, which caused the young players to be overburdened and bored with the training. This causes serious damage to the internal organs and supporting sports organs of children and adolescents. Failure to take the necessary measures will cause sports injuries to the young players and cause catastrophic consequences. This will make it difficult for athletes to return to normal conditions for a long time and even ruin the competitive career of many sports talents. Therefore, coaches should give full consideration to the physical characteristics of the young athletes in training and gradually increase the auxiliary exercises and basic exercises in the special events. Scientifically arrange the training load of young athletes and avoid the "single one" mode of training content. In particular, it is necessary to avoid local overload and strengthen recovery measures and supervision after training. Only in this way can the probability of occurrence of sports injuries be reduced.

CONCLUSION

Four important factors lead to the sports injury of young rhythmic gymnasts in China, including poor physical fitness, unreasonable warm-up activities, incorrect technical methods, and excessive local burdens. In training, it is necessary to follow the growth and development of the human body and arrange multi-year training programs scientifically and systematically. The coach is making a gradual training plan with traditional Chinese medicine, focusing on long-term effects. This enables athletes to achieve their best athletic performance at an appropriate age.

All authors declare no potential conflict of interest related to this article

AUTHORS' CONTRIBUTIONS: Each author made significant individual contributions to this manuscript. Zhijuan Du: writing; Guangyong Zhao: data analysis and article review.

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