

PREVENTING SPORTS INJURIES IN THE PROCESS OF PHYSICAL FITNESS TRAINING



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PREVENINDO LESÕES ESPORTIVAS NO PROCESSO DE TREINAMENTO DE APTIDÃO FÍSICA

PREVENIENDO LESIONES DEPORTIVAS EN EL PROCESO DE ENTRENAMIENTO DE APTITUD FÍSICA

Kunxia Su^{1,2}
(Physical Education Professional)
Lijun Wu³
(Physical Education Professional)
Guangtao Zhao³
(Physical Education Professional)
YuJiao Li¹
(Physical Education Professional)

1. Department of Sports,
Zhongyuan Institute of Science
and Technology, Zhengzhou,
Henan, China.

2. College of Art and Physical
Education, Gangneung-Wonju
National University, Gangneung,
Korea.

3. Physical Education College,
Henan Finance University,
Zhengzhou, Henan, China.

Correspondence:

Lijun Wu
Zhengzhou, Henan, China. 450046.
sukx888@163.com

ABSTRACT

*Introduction: It is common for athletes to have accidental injuries in training. Sports injuries damage the health of athletes, dampen their enthusiasm, and affect their normal life and training. Objective: To explore preventive measures against athletes' sports injuries by understanding their sports injuries. Methods: We used the literature data method, a questionnaire, an interview, and mathematical statistics to determine the cause of sports injury accidents of athletes. Results: The locations of sports injuries were fingers, ankle and knee joints, lower back, thighs, etc. Common types of injuries were joint sprains, muscle strains, and soft tissue injuries. Conclusion: Scientific physical training can prevent sports injuries and effectively reduce injuries and accidents caused by sports. **Level of evidence II; Therapeutic studies - investigation of treatment results.***

Keywords: Athletes; Athletic Injuries; Sports.

RESUMO

*Introdução: Não é raro que atletas tenham ferimentos acidentais em seus treinamentos. Lesões esportivas causam danos à saúde dos atletas e reduzem seu entusiasmo, afetando suas vidas normais e seu treino. Objetivo: Explorar medidas preventivas contra lesões esportivas para compreender como tais ferimentos ocorrem. Métodos: Este trabalho utilizou pesquisa bibliográfica, questionário, entrevista, e cálculo estatístico matemático para determinar a causa das lesões esportivas acidentais de atletas. Resultados: As lesões esportivas ocorreram em dedos, articulações de tornozelo e joelho, região lombar, coxas e etc. Tipos comuns de lesão incluíram torção de articulações, estiramento muscular, e feridas em tecidos moles. Conclusão: O treino físico com base científica pode prevenir lesões esportivas e efetivamente reduzir os ferimentos e acidentes causados pelo esporte. **Nível de evidência II; Estudos terapêuticos – investigação de resultados de tratamento.***

Descritores: Atletas; Traumatismos em Atletas; Esportes.

RESUMEN

*Introducción: No es raro que los deportistas sufran lesiones accidentales en sus entrenamientos. Lesiones deportivas causan daños a la salud de los atletas y reducen su entusiasmo, afectando sus vidas normales y su entrenamiento. Objetivo: Explorar medidas preventivas contra lesiones deportivas para comprender cómo tales heridas ocurren. Métodos: Este trabajo utilizó investigación bibliográfica, cuestionario, entrevista y cálculo estadístico matemático para determinar la causa de las lesiones deportivas accidentales de atletas. Resultados: Las lesiones deportivas ocurrieron en los dedos, articulaciones de los tobillos y rodillas, región lumbar, muslos, etc. Entre los tipos de lesiones más comunes se encuentran los esguinces articulares, las distensiones musculares y las heridas en los tejidos blandos. Conclusión: El entrenamiento físico con base científica puede prevenir lesiones deportivas y efectivamente reducir las heridas y accidentes causados por el deporte. **Nivel de evidencia II; Estudios terapéuticos – investigación de resultados de tratamiento.***

Descriptorios: Atletas; Traumatismo en Atletas; Deportes.



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INTRODUCTION

The article assumes that the research object causes the athlete's sports injury accident. It analyzes the basic concepts, main characteristics, and accident types in sports injury accidents of athletes.¹ Integrate the model structure of the cause of sports injury accidents for athletes. This can provide a theoretical basis and practical reference for probing the causes of sports injury accidents of athletes and scientifically preventing the occurrence of sports injury accidents of athletes.

METHOD

Research object

The article takes the model structure of the cause of sports injury accidents of athletes as the research object.

Research methods

Literature data method

We searched a total of 61 related documents in the past 20 years with keywords such as athletes, sports injury accidents, and cause model

structures. We classify and organize documents that are highly relevant to this research.² This provides literature support for the construction of the causal model of sports injury accidents for athletes.

Interview method

We interviewed athletes, coaches, and team doctors to learn about sports injury accidents during sports training.³ We summarized their views and opinions on the causes of athletes' sports injury accidents to construct a model of the causes of athletes' sports injuries.

Questionnaire survey method

We selected 141 athletes with a history of sports injury accidents and 22 sports-related field experts.⁴ A total of 132 questionnaires were returned to the "Study on the Model Structure of Athletes' Sports Injury Accidents" questionnaires. There are 128 valid questionnaires, the recovery rate is 93.6%, and the effective rate is 97%. There were 21 expert questionnaires and 21 valid questionnaires. The recovery rate was 95.5%, and the effective rate was 100%.

Mathematical Statistics

We use Excel and AMOS17.0 software to perform data processing and statistical analysis on the collected and integrated research information.⁵ Then we summarize the survey results and analyze the status quo and development countermeasures.

Analysis algorithm of second-order Bessel fading model of athlete's metabolic function

Firstly, the shortest aerobic metabolism time, the aerobic metabolism efficiency, and the anaerobic metabolism ratio are used as the model input parameters to construct the three-parameter model input matrix as

$$A = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \quad (1)$$

a_{11} represents the autocorrelation characteristic of the shortest aerobic metabolism time. a_{22} represents the autocorrelation characteristic of aerobic metabolism. a_{33} indicates the autocorrelation characteristic of the anaerobic metabolism ratio.⁶ The autocorrelation characteristics of the model input parameters characterize the stability of the model. Based on the construction of the input parameter matrix, we obtain the second-order Bessel fading model equation as

$$ADV = \begin{bmatrix} 0.86 & 0.86/d_1 & 0.86/d_2 \\ 1.00 & 1.00/d_1 & 1.00/d_2 \\ 0.95 & 0.95/d_1 & 0.95/d_2 \end{bmatrix} \quad (2)$$

ADV represents the characteristic equation of the second-order Bessel fading model. d_1 represents the correlation distance between the shortest aerobic metabolism time and the effective rate of aerobic metabolism. d_2 represents the relative distance between the shortest aerobic metabolism time and the ratio of anaerobic metabolism.⁷ The analysis process based on the second-order Bessel fading model is as follows:

$$A = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix}, M = \begin{bmatrix} m_{11} & m_{12} & m_{13} \\ m_{21} & m_{22} & m_{23} \\ m_{31} & m_{32} & m_{33} \end{bmatrix} \quad (3)$$

$$ADV = \begin{bmatrix} 0.86 & 0.86/1.11 & 0.86/2.22 \\ 1.00 & 1.00/1.11 & 1.00/2.22 \\ 0.95 & 0.95/1.11 & 0.95/2.22 \end{bmatrix}$$

RESULTS

Definition of related concepts

Sports injury accidents of athletes: mainly refer to athletes' injuries in sports activities such as physical education, extracurricular sports activities, after-school training, and various sports competitions.⁸

The model structure of the cause of sports injury accidents: The model structure mainly refers to the highly refined and simplified representation of certain things. The model structure of the cause of sports injury accidents is a structured representation of the causes.

Model construction

Theoretical analysis

Related accident causation theories can analyze and deduced the causal factors of sports injury accidents.⁹ At present, the most recognized accident cause theory includes "human error theory," "trajectory intersection theory," "management error theory," and "comprehensive theory." "Human error theory" believes that human factors mainly cause errors. The "trajectory intersection theory" believes that errors are caused by the intersection of human and material factors. "Management error theory" believes that the accident occurred because of the unsafe behavior and unsafe conditions of people and things caused by insufficient norms. The "comprehensive theory" believes that accidents are caused by the combined effect of a variety of adverse factors, including social factors. The causal factors of sports injury accidents should include human, physical, management, and social factors. Based on the above factors, the first-order conceptual structure of the causal model of athletes' sports injury accidents is designed. (Figure 1)

Empirical research

Results of interviews with coaches

Through the interviews with coaches and the summary and analysis of the content, it is found that teachers believe that the causes of sports injury accidents of athletes are mainly composed of athlete factors and social factors.¹⁰ Among them, the factors of athletes mainly include three sub-causes: insufficient awareness of safe exercise, poor physical fitness, and poor athletic ability. The social factors mainly include 4 sub-causes that athletes have poor eating habits, heavy schoolwork, a large number of classes, and athletes' parents not paying attention to physical exercises during the growth of athletes.

Results of interviews with team doctors

After summarizing and analyzing the interviews with 7 team doctors, it is found that the team doctors believe that the causes of sports injury accidents mainly include venue and environmental factors, athlete factors, and social factors. The venue and environmental factors mainly include

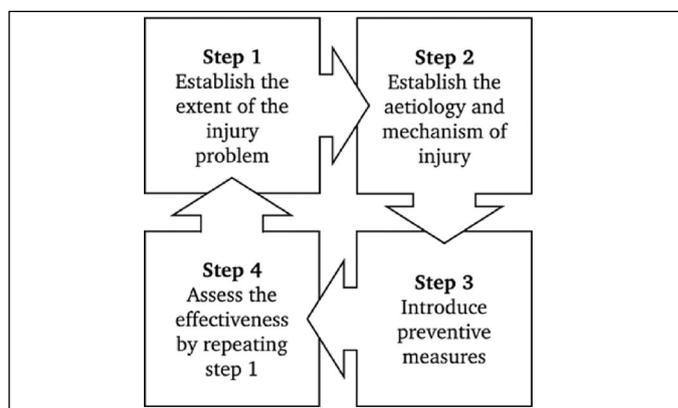


Figure 1. The first-order conceptual structure of the cause of sports injury accidents for athletes.

two sub-causes, bad weather, and imperfect sports venues. Athlete factors mainly include two sub-causes: weak awareness of safe exercise, poor physical fitness, and disease. The social factors mainly include two sub-causes of the athlete's greater pressure and unscientific diet.

Results of interviews with athletes

Through interviews with 56 athletes with a history of sports injuries in three institutions, it is found that the athletes believe that their own sports injury accidents are mainly caused by their factors, field factors, and teacher factors. Among them, the factors of athletes mainly include three sub-causes: insufficient awareness of safe exercise, poor physical fitness, and poor athletic ability. Site factors mainly include two sub-causes of the imperfect site and lack of facilities. Teacher factors mainly include two sub-causes: improper teaching organization and a weak sense of responsibility.

Observations of classroom teaching

Through the observation of the physical education classroom teaching, it is found that there are hidden dangers of sports injury accidents in the four aspects of teachers, sports venues, athletes, and society in the classroom teaching. Teacher factors mainly include three sub-causes: poor sense of responsibility, improper teaching management, and insufficient safety awareness. Venue factors mainly include two sub-causes: insufficient venue, poor lighting, and ventilation in the gymnasium. Athlete factors mainly include three sub-causes: poor preparation activities, poor classroom discipline, and risk-taking behavior.

Preliminary construction of the model

According to Figure 1 based on the statistics of the related literature on sports injury accidents of athletes in the past 20 years, the model structure of athletes' cause of sports injury accidents is initially constructed. The content includes four first-order causes: people, things, management, and society. Teacher factors, athlete factors, venue facilities, sports environment, human management, material management, national, local, and family 8 second-order causes, and 25 third-order causes such as safe teaching awareness, teaching ability, and physical fitness. (Figure 2)

Verification of the model structure

Questionnaire verification for athletes and experts

The causal model constructed tests the objectivity and recognition of the causal factors of athletes' sports injury accidents. We distributed the

"Athlete Sports Injury Accident Causation Model Structure Questionnaire" verification questionnaire to 128 athletes with a history of sports injury accidents and 21 sports-related field experts. The results show that both athletes and experts have a high degree of recognition of most of the causes in the model structure of athletes' sports injury accidents. They did not agree with the structural factors of the two causal models: "teacher inadequate lesson preparation" and "large exercise load." The athlete's recognition rate was 12.3% and 20.6%, and the expert recognition rate was 19% and 9.6%, respectively. Therefore, it is excluded from the causal model structure.

Statistical quality verification

The fitting structure effect is a common method to verify the quality of the structure statistically. Commonly used relevant indicators include $\chi^2/d, p, \chi^2/df$ (chi-square degree of freedom ratio), NNFI (non-standard fitting index), AGFI (adjusted goodness of fit index), CFI (comparative fitting index), RMSEA (Root Mean Square Approximation Error). /df should be within 0-2. NNFI, AGFI, and CFI are between 0 and 1. The closer it is to 1, the better. RMSEA close to 0 indicates a good fit. The farther away from 0, the worse the fit. According to the information obtained in the "Athlete Sports Injury Accident Causation Model Structure Questionnaire," statistical processing was performed. The results are shown in Table 1.

Table 1 shows that the χ^2/df value of the primary structure is 1.698, and the result is between 0 and 5. The values of NNFI, AGFI, and CFI were 0.936, 0.929, and 0.961, respectively. The above values are all close to 1. The RMSEA value is 0.064, which is in the optimal range of 0.05 to 0.08. This shows that the fitting effect of the primary structure caused by sports injury accidents of athletes is ideal, and the quality of the structure is

Table 1. The structural quality inspection index of the causal model of athletes' sports injury accidents.

Structure	Primary structure	Secondary structure
χ^2	37.362	59.218
df	21	23
P	0.02	0.000
χ^2 / df	1.698	2.820
NNFI	0.936	0.935
AGFI	0.929	0.910
CFI	0.961	0.859
RMSEA	0.064	0.073

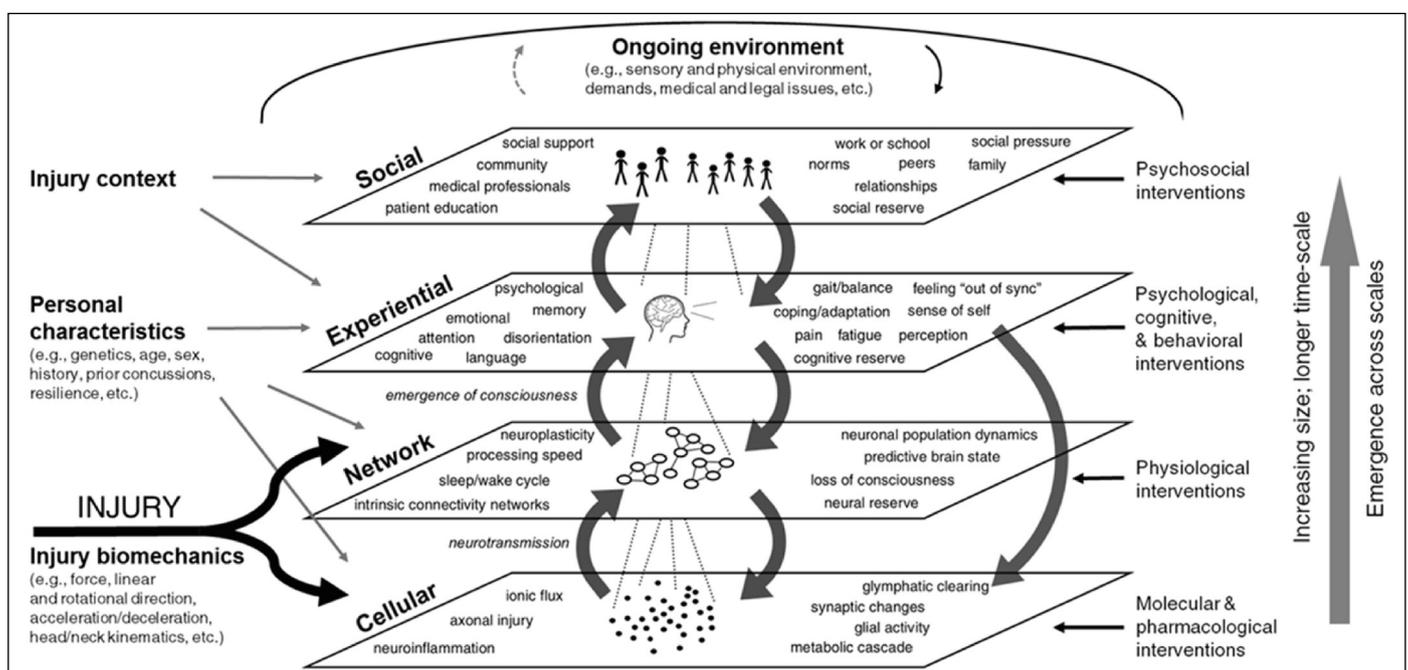


Figure 2. Preliminary construction of the causal model of athletes' sports injury accidents.

better. The χ^2/df value of the secondary structure is 2.820, which is also between 0-5. The NNFI, AGFI, and CFI values are 0.935, 0.910, and 0.859, respectively, and they are all close to 1. The RMSEA value is 0.073, which is in the optimal range of 0.05-0.08. This shows that the fitting effect of the secondary structure of the athlete's sports injury accident model is ideal, and the structural quality is better.

DISCUSSION

According to the verification of athletes and experts, combined with the statistical quality verification of the model structure, the final structure of the athlete's sports injury accident cause model was constructed. (Figure 3)

According to the structure of the causal model, teachers should firmly establish safety awareness and a sense of responsibility and scientifically arrange physical education and training. Athletes should read more information about sports injury accidents to improve their safety awareness. At the same time, athletes should strengthen their physical fitness.

Schools should increase their investment in sports funds and strengthen the improvement of school sports material conditions. Schools, teachers, and parents should actively guide athletes to develop healthy habits. Parents of athletes also need to improve their knowledge of sports safety and provide supervision and advice for athletes' sports safety.

CONCLUSION

The model structure of athletes' cause of sports injury accidents consists of 4 first-order causes (human, material, management, and social factors) and 8 second-order causes (teacher, athletes, venue facilities, sports environment, human management, and physical management), National, local, and family), as well as 23 third-level causes including teachers' safety education awareness, teaching ability, and athlete's physical condition.

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

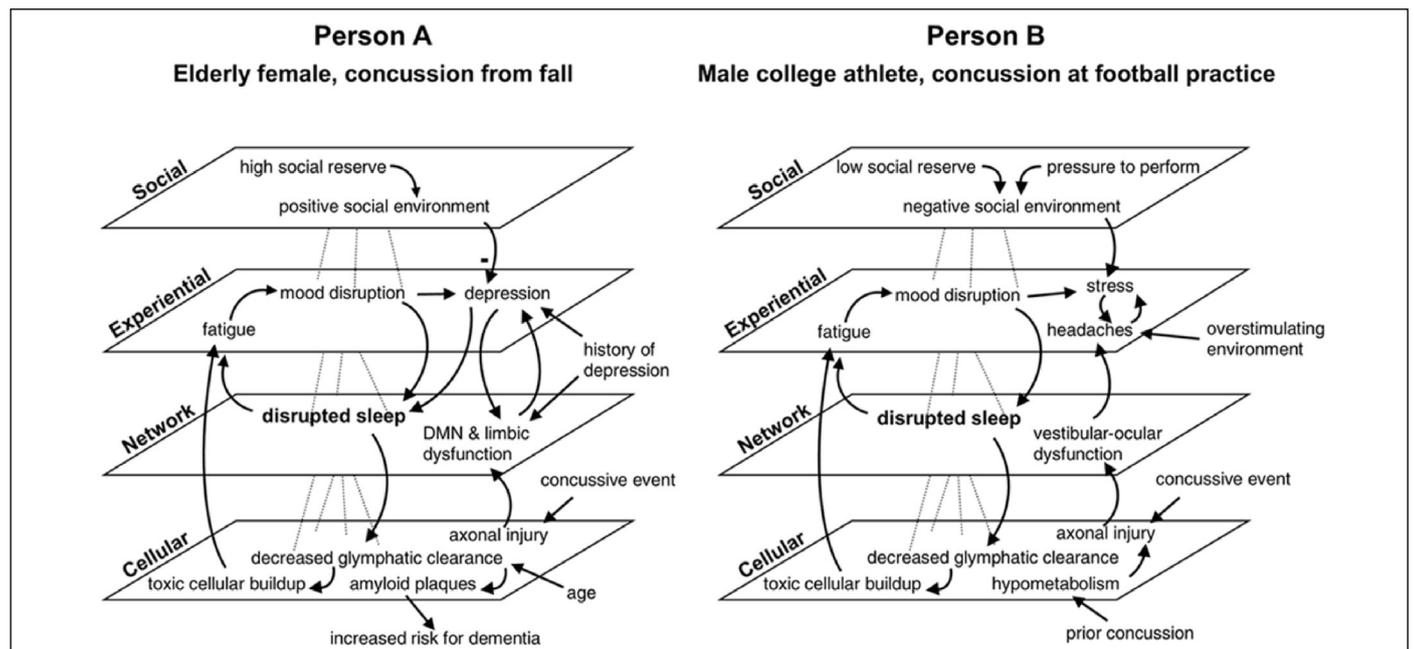


Figure 3. The cause structure of athletes' sports injury accidents.

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