

Retraction

Retracted: Early Warning System of Tennis Sports Injury Risk Based on Mobile Computing

Mobile Information Systems

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

- (1) Discrepancies in scope
- (2) Discrepancies in the description of the research reported
- (3) Discrepancies between the availability of data and the research described
- (4) Inappropriate citations
- (5) Incoherent, meaningless and/or irrelevant content included in the article
- (6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

In addition, our investigation has also shown that one or more of the following human-subject reporting requirements has not been met in this article: ethical approval by an Institutional Review Board (IRB) committee or equivalent, patient/participant consent to participate, and/or agreement to publish patient/participant details (where relevant).

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

- [1] Y. Li, K. Kim, and Y. Ding, "Early Warning System of Tennis Sports Injury Risk Based on Mobile Computing," *Mobile Information Systems*, vol. 2021, Article ID 3278276, 10 pages, 2021.

Research Article

Early Warning System of Tennis Sports Injury Risk Based on Mobile Computing

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In recent years, sports injuries in professional tennis players have gradually increased and sports injuries will break the sports training system and affect the long-term growth of new tennis players. Avoiding athlete injuries has become an important factor in improving training quality and game performance and ensuring the sustainable development of young tennis players' competitiveness. Therefore, this article will use the RBF neural network algorithm and cluster analysis method to establish a tennis sports injury risk early warning model and finally establish a tennis sports injury risk early warning system so that tennis players can reduce their injuries. In this article, we use the questionnaire survey method, expert interview method, mathematical statistics method, and logical analysis method to investigate and analyze the results of training injuries of Chinese tennis players and coaches. The experimental results in this article show that among 48 tennis players of different ages, who are participating in formal training and tennis competitions, 15 young tennis players have been injured more than 6 times, accounting for 31.2% of the total; 20 have been injured 3 to 6 times, accounting for 41.7% of the total; 9 of them have been injured several times, accounting for 18.8% of the total; and 4 have been injured, accounting for 8.3% of the total. After using the tennis sports injury risk warning system based on the algorithm of RBF neural network in mobile computing, the tennis sports injury rate has dropped to 5%. It can be seen that the system has high feasibility and practicability.

1. Introduction

1.1. Background. At present, the competitive training system for young tennis players in China has basically taken shape, and the training model tends to be standardized and systematized. However, for a long time, the development of competitive tennis in our country has faced arduous problems, and many people have suffered various degrees of sports injuries. The occurrence of sports injuries destroys the sports training system and affects the long-term growth of new tennis players. Young tennis players must receive years of systematic scientific training. While improving their athletic ability and physical condition, they constantly accumulate game experience, gradually improve their athletic ability, and thus grow into excellent professional tennis players. Long-term injuries also bring heavy psychological burdens to young tennis players, which reduce their desire

for training and competition and significantly reduce their training results. Many excellent tennis players have suffered injuries and illnesses in adulthood, unable to achieve good sports performance, and must end their sports career as soon as possible. As a result, sports injuries have a major impact on the professional development of young tennis players and also seriously waste the country's human and financial resources. Knowing how to avoid athletes' injuries during training and competitions is very important for young tennis players to improve the quality of training and sports performance and ensure the sustainable development of their competitiveness. Mobile computing is a general term for technologies that allow people to access network services (data and calculations) uninterruptedly at any time, any place, and during exercise. Mobile refers to driving wireless network technology. Computing refers to computing in a network environment.

1.2. Significance. Young tennis players are the main force in cultivating competitive tennis talents in our country. They are the diet and hope of Chinese tennis in the future. The occurrence of sports injuries will limit the competitiveness of young tennis players and will have a significant impact on their sports career development. Reducing or avoiding sports injuries of young athletes is a very important issue to be addressed. This article takes adolescent tennis players as the research objects, investigates and studies the current situation of sports injuries, analyzes the characteristics and causes of sports injuries through the research results, summarizes the laws of general sports injuries, and proposes corresponding countermeasures, from an educational point of view. The research results play an important role in preventing and reducing youth tennis injuries, improving the overall training level, improving the quality of talent training, and extending the lifespan of athletes. It also provides specific theoretical references for young tennis players, so that they can better understand the characteristics of injuries, improve their awareness of protection in training and competitions, and master the ability of self-defense. The coach uses scientific training methods to organize the intensity and schedule training reasonably. Mobile computing provides strong technical support for the tennis sports injury risk early warning system.

1.3. Related Work. The study of sports injuries is very important. Vescovi read the study by Myers et al. with great interest and investigated the relationship between workload and injury risk of young tennis players [1]. Hereinafter, several items have been mentioned in terms of improving method transparency and understanding of results. However, since the experimental environment is not closed, there is a certain deviation in the experimental results. In order to study whether sports training has an impact on the body, Drew et al. conducted a research that shows that training load will increase the risk of sports injuries, but it is rarely considered to reduce the burden in the framework of sports injury prevention. A key concept behind monitoring the training load used to prevent injuries is to screen those who are at increased risk of injury so that the workload can be adjusted to minimize these risks. Drew et al. also describe how advancements in workload management can be used as preventive measures. Primary prevention includes screening for preload risk factors such as low training load during the training period or before the competition. Secondary prevention involves screening known workloads before the injury develops so that modifications can be made to mitigate this risk. Tertiary prevention involves rehabilitation practices, including a graded return training program to reduce the risk of subsequent injuries. Now the relationship between training load and injury incidence can be established [2]. Although it meets expectations in most directions, it does not mention personal physical factors due to external environmental factors. In some parts of the forecast, there are errors. Whether athletes usually suffer from Achilles tendon injury is a difficult problem. Hasan and Latif's

research shows that in industrialized countries, widespread spontaneous rupture has increased. The basic cause of Achilles tendinitis is multifactorial. Several susceptible external and internal factors are attributed to this problem. Epidemiological studies report that misalignment of lower limbs and biomechanical defects play a causal role in two-thirds of athletes with Achilles tendon injuries. Athletes with Achilles tendinopathy are more likely than other complainants to have restricted foot rotation, subtalar range of motion, difference in leg length, and restricted range of motion of the ankle joint [3]. Although the research perspective is forward-looking, there remain many unachievable parts of the technology.

1.4. Innovations. The innovations of this article are as follows: (1) try to use the RBF neural network in the machine learning algorithm, which is mostly used for predictive model construction, to construct a model for the early warning of a tennis sports injury and (2) use gray-cluster association analysis to screen tennis sports injuries risk and construct a tennis injury risk index system.

2. Evaluation of the Prewarning Level of Sports Injuries

This paper mainly uses the RBF neural network to distinguish whether the sports injury risk warning level is high, medium, or low according to the input information, which is divided into three categories based on the size of the sports injury risk. Mobile computing is a new technology that has emerged with the development of technologies such as mobile communications, the Internet, and distributed computing. Mobile computing technology will enable computers or other information intelligent terminal equipment to realize data transmission and resource sharing in a wireless environment and transfer information to a distributed computing environment under a remote server, which can transfer useful, accurate, and timely information provided to any customer at any time and any place, to provide users with a ubiquitous mobile computing environment, which will greatly change people's lifestyles and working methods. The risk early warning system is based on the characteristics of the research object, by collecting relevant data and information, monitoring the changing trend of risk factors, evaluating the degree of deviation from the early warning line of various risk states, sending early warning signals to the decision-making level, and taking precontrol in advance as the system of countermeasures.

2.1. Basic Principles of RBF Neural Network. The basic idea of the RBF (radial basis function) neural network is to use RBF as the "base" of the hidden unit to form the hidden layer space [4, 5]. The hidden layer converts the input carrier and the poorly performing input data into a dimensional space [6]. The activation function of the RBF neural network can be expressed as follows:

$$R(x_p - c_i) = \exp\left(-\frac{1}{2\delta^2}\|x_p - c_i\|^2\right). \quad (1)$$

Among them, the structure of the RBF neural network can get the output of the network as follows:

$$y_j = \sum_{i=1}^h \omega_{ij} \exp\left(-\frac{1}{2\delta^2}\|x_p - c_i\|^2\right), \quad j = 1, 2, 3, \dots, n. \quad (2)$$

(1) Algorithm of RBF neural network

The purpose of RBF network training is to find the final weights A , B , and C of the two layers. The training process is divided into two steps: the first step is unsupervised learning where the training determines the weights A and B between the input layer and the hidden layer, and the second step is supervised learning where the training determines the difference between the hidden layer and the output layer weight C . Before training, provide the input vector X , the corresponding target output vector Y , and the width vector B of the radial basis function [7, 8]. Given the values of η and the value of the iteration termination accuracy s , where n is the number of input layer units, q is the number of output layer units, and p is the hidden layer unit number

(1) Determine the input vector X :

$$X = [x_1, x_2, \dots, x_n]^T. \quad (3)$$

(2) Determine the output vector Y and the desired output vector o :

$$Y = [y_1, y_2, \dots, y_q]^T, \quad (4)$$

$$O = [o_1, o_2, \dots, o_q]^T.$$

(3) Initialize the connection weights from the hidden layer to the output layer:

$$W_k = [w_{k1}, w_{k2}, \dots, w_{kq}]^T, \quad k = 1, 2, \dots, q. \quad (5)$$

(4) Initialize the central parameter $C_j = [c_{j1}, c_{j2}, \dots, c_{jn}]^T$ of each neuron in the hidden layer (p is the total number of neurons in the hidden layer):

$$c_{ij} = \text{mini} + \frac{\text{maxi} - \text{mini}}{2p} + (j-1) \frac{\text{maxi} - \text{mini}}{p}, \quad j = 1, 2, \dots, p. \quad (6)$$

(5) Initialize the width vector $D_j = [d_{j1}, d_{j2}, \dots, d_{jq}]$:

where d_f is the width adjustment coefficient, the value is less than 1, and the function is to make each hidden layer neuron easier to realize the ability to perceive local information, which is beneficial to improve the local response ability of the RBF neural network [8, 9].

(2) Calculate the value of the root-mean-square (RMS) error of the network output. If $\text{RMS} \leq \varepsilon$, the training ends; otherwise, it goes to step (c) to calculate the output layer neuron output [10].

$$\text{RMS} = \sqrt{\frac{\sum_{i=1}^N \sum_{k=1}^q (O_{ik} - y_{lk})^2}{qN}}. \quad (8)$$

(3) Calculate iteratively the weight parameters.

Here, the method of calculating the weight parameters of the RBF neural network is called the gradient grading method. Through learning, the center, width, and weight adjustment parameters are adaptively adjusted to the best values [11, 12]. The iterative calculation is as follows:

$$w_{kj}(t) = w_{kj}(t-1) - \mu \frac{\partial E}{\partial w_{kj}(t-1)} + \alpha [w_{kj}(t-1) - w_{kj}(t-2)], \quad (9)$$

$$c_{ji}(t) = c_{ji}(t-1) - \mu \frac{\partial E}{\partial c_{ji}(t-1)} + \alpha [c_{ji}(t-1) - c_{ji}(t-2)], \quad (10)$$

$$d_{ji}(t) = d_{ji}(t-1) - \mu \frac{\partial E}{\partial d_{ji}(t-1)} + \alpha [d_{ji}(t-1) - d_{ji}(t-2)], \quad (11)$$

where $w_{kj}(t)$ is the adjustment weight between the k -th output neuron and the j -th hidden layer neuron in the t -th iterative calculation, and $c_{ji}(t)$ is the j -th hidden layer neuron in the t -th input neuron. In the central component of the second iteration calculation, $d_{ji}(t)$ is the width corresponding to the center, μ is the learning factor, and E is the evaluation function of the RBF neural network:

$$E = \frac{1}{2} \sum_{l=1}^N \sum_{k=1}^q (y_{lk} - O_{lk})^2, \quad (12)$$

where O_{lk} is the expected output value of the k -th output neuron at the first input sample, and y_{lk} is the network output value of the k -th output neuron at the first input sample [13, 14].

2.2. Basic Principles of Cluster Analysis

2.2.1. Data Preprocessing.

Data preprocessing involves the selection of the number, type, and scale of attributes, which depends on function selection and characteristic export. Function selection selects important functions, and characteristic export converts input attributes into new attributes [15]. These are usually used to obtain appropriate feature sets and group them to avoid "size destruction." Data preprocessing also includes the removal of extremes from the data. Limit data is data that has nothing to do with general

data behavior or models. Therefore, extreme values usually lead to deviations, and edges must be removed to group them correctly [16, 17].

2.2.2. Determine the Distance between the Samples.

When determining the distance between samples, the Euclidean distance d is generally used for calculation. The Euclidean distance in two-dimensional and three-dimensional spaces is the actual distance between two points. The calculation formula is as follows:

$$d_{ij} = \left[\sum_{k=1}^p (X_{ik} - X_{jk})^2 \right]^{1/2}, \quad i = 1, 2, 3, \dots, n, j = i + 1, i + 2, \dots, n. \quad (13)$$

2.2.3. Determine the Distance between Classes.

When determining the distance between classes, a well-classified and widely used square method is usually used. The basic idea is to collect n samples in a class automatically. Currently, the sum of squares of deviations is 0, and then this category is subtracted, that is, the sum of squares of the deviations will increase every time the category is reduced, thereby minimizing the increase in the two categories [18, 19]. Select and merge by the sum of squared deviations [20]. Until all samples are classified into one category, first calculate the square of the distance from each sample to the class mean as follows:

$$S_t = \sum_{i=1}^{n_t} (X_{it} - \bar{X})X_{it} - \bar{X}. \quad (14)$$

Then, calculate the sum of squared deviations of all within classes of all samples:

$$S = \sum_{t=1}^k S_t = \sum_{t=1}^k \sum_{i=1}^{n_t} (X_{it} - \bar{X})(X_{it} - \bar{X}). \quad (15)$$

2.2.4. Determine the Number of Clusters. The ratio D of the average distance within the class and the average distance between the classes has to be used to determine the optimal cluster number K according to the actual situation of the research problem. Different cluster numbers have different D values. The smaller the D value, the better the clustering, but the number K should not be too large and should be selected according to actual conditions. The formula to calculate the D value is as follows:

$$D = \frac{\text{average distance within a class}}{\text{average distance between classes}}. \quad (16)$$

2.2.5. Output Clustering Results. Use analysis software such as MATLAB or SPSS to analyze the above steps in practice, express the whole process in a clustering pedigree diagram similar to a tree structure diagram, and finally decompose the clustering pedigree diagram according to the determined

optimal number of clusters. Analyze and output the final clustering results [21].

3. Establishment of an Early Warning Model for Tennis Injury Risk

3.1. Research Objects and Research Methods

3.1.1. Research Object. This article takes the sports injuries of young tennis players in my country as the research object. A total of 50 young tennis players and 10 tennis coaches from the four units of Zibo Sports School in Shandong Province, Fuxin Tennis Amateur Sports School in Liaoning Province, Shenyang Xingguo Tennis Club in Liaoning Province, and Anshan Sports School in Liaoning Province are selected as subjects of investigation. Among them, 27 are male athletes, and 23 are female athletes; they are 13–18 years old, with an average age of 15 years; tennis training period is 3–8 years, with an average of 4 years; and there are 2 national first-level athletes, accounting for 4% of the total number and 17 national second-level athletes, accounting for 34% of the total number. The average length of coaching for coaches is 5 years.

3.1.2. Research Methods

(1) Questionnaire Survey Method. In order to gain a deeper understanding of the current situation, characteristics, and causes of sports injuries of young tennis players in my country, a questionnaire survey was conducted among 50 young tennis players aged 13–18 and 10 tennis coaches (Tables 1 and 2).

This study designed the “questionnaire validity checklist”, in which several experts were asked to evaluate whether the structure and content of the questionnaires for athletes and coaches are complete and effective. Put 5 levels as very effective, effective, general, not very effective, and ineffective as the evaluation criteria

It can be seen from Table 3 that all experts believe that the structure of the questionnaire is reasonable; the content is effective, meets the established design requirements, can reflect the corresponding questions, and the questionnaire has high validity.

(2) Expert Interview Method. In order to gain insights into the status quo, regularity, causes of injuries, and preventive measures of young tennis players’ sports injuries and verify the correctness and scientificity of the relevant arguments of this research, the authors have been engaged in tennis teaching and training, sports training, and sports physiology all the year-round. Experts, professors, and coaches in related disciplines such as sports medicine have been interviewed and surveyed, which consolidated the research foundation of this article.

(3) Mathematical Statistics. The relevant knowledge of statistics has been used; the Excel and SPSS software have been used to perform statistics and analysis on the data obtained

TABLE 1: Reliability test of athlete questionnaire.

Number of retests	Intervals	Correlation coefficient	<i>p</i> value
12	10	0.865	$p < 0.01$

TABLE 2: Reliability test of the coach questionnaire.

Number of retests	Intervals	Correlation coefficient	<i>p</i> value
4	10	0.895	$p < 0.01$

TABLE 3: Validity test of questionnaire.

Grade	Number of people	Very effective	Effective	General	Not very effective	Invalid
Professor	3	0	3	0	0	0
Associate professor	2	1	2	0	0	0
Senior coach	2	1	1	0	0	0
Total	8	2	6	0	0	0
Percentage	100%	25%	75%	0	0	0

after the survey; and the references and basis for the relevant argumentation of this research have also been provided.

(4) *Logic Analysis Method*. The results of the questionnaire are sorted out and analyzed and combined with the physiological and technical characteristics of young tennis players to demonstrate the arguments of this article.

3.2. *System Architecture*. The system follows the principles of practicability, adaptability, scalability, reliability, and safety. Based on information related to athletes' personal sports training, it manages track and field training information anytime and anywhere and provides early warning of sports injury risks. The system provides track and field information services to users through WLAN and 5G. The specific operating topology is as follows (Figure 1).

The system uses the deployed web server to perform critical early warning tasks. Athletes send information through wireless mobile devices, receive services, and respond. The wireless mobile device interacts with the network server in real-time through the wireless network to provide physical education data query and early sports injury alert.

3.3. *Injury-Causing Factors of Sports Injuries*. Traditionally, the risk factors leading to sports injuries are divided into two categories: internal and external [21]. However, it is not enough to explain the appearance of sports injuries from internal and external factors. In order to determine a complete model of the mechanism of sports injury, the interaction between various factors and the role of the event that caused the injury must also be considered. Figure 2 is a statistical diagram of internal damage factors.

Factor analysis uses the component method to extract common factors and extracts them based on the attribute value greater than 1. The attribute value of the five main factors is greater than 1, and the cumulative contribution is 86.369% (i.e., the 26 initial variables are divided into five main factors), which meets the basic requirements for the

total amount of information. It can be seen that the above factors reflect most of the information in the initial variables. Therefore, these five factors have been identified as the main factors affecting the risk factors of tennis injury. Figure 3 is a statistical diagram of the extraction results of factor analysis in factor analysis.

3.4. *Selection of Evaluation Indicators for Sports Injury Risk Factors*. After the risk is established, risk filtering can be carried out in the following three stages. The first step is scenario filter; the defined risk scenarios are filtered according to the responsibilities and interests of the current users of the system. This stage usually filters risk scenarios based on professional experience. The second stage is double-standard filtering and evaluation, and with the help of quality characteristics and results, the remaining risk scenarios are further filtered [22]. At this stage, we need two risk measures, namely, probability and severity. The third stage is a multicriteria evaluation using a set of n indicators, which link the capabilities of the risk program with the defense of the defense system. These indicators are controllability, perceivability, multiple failure modes, reversibility, impact duration, impact overlap, operating environment, and design maturity [23].

The three stages of this risk filtering method are mainly aimed at risk problems in large-scale systems. Some of the indicators are not suitable for the study of this article, but we can summarize some indicators suitable for this article from the theory to analyze sports injuries in tennis events. Through interviews with experts, according to the research requirements of this article, indicators with possibility, severity, and controllability have been selected to evaluate their sports injury risk factors [24].

3.5. *Methods of Assessing Risk Factors for Sports Injuries*. According to expert interviews and previous research on risk factors by previous scholars, risk factor assessment uses a combination of three indicators such as risk occurrence,

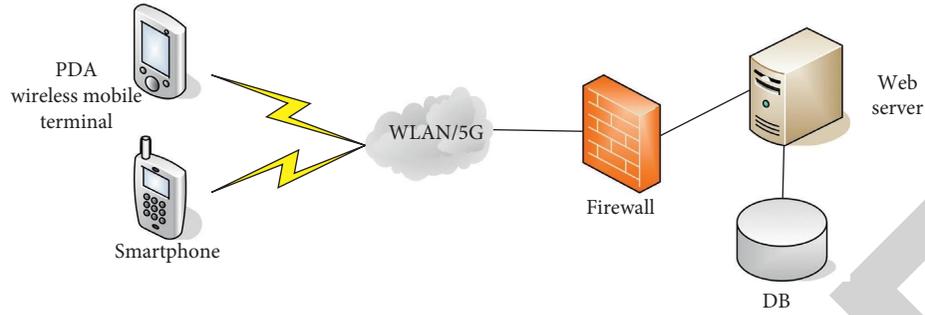


FIGURE 1: System topology diagram.

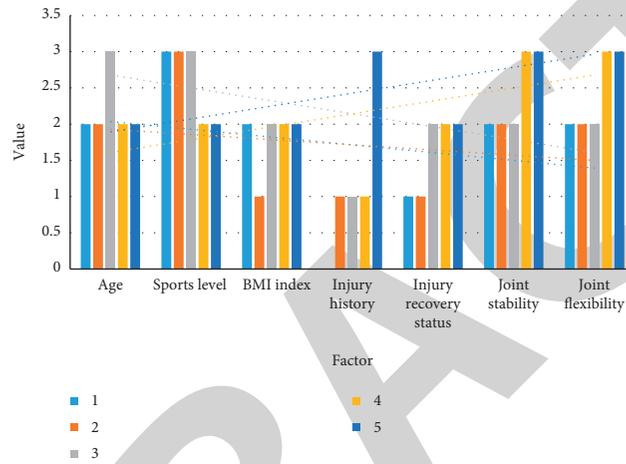


FIGURE 2: Statistical graph of internal damage factor information.

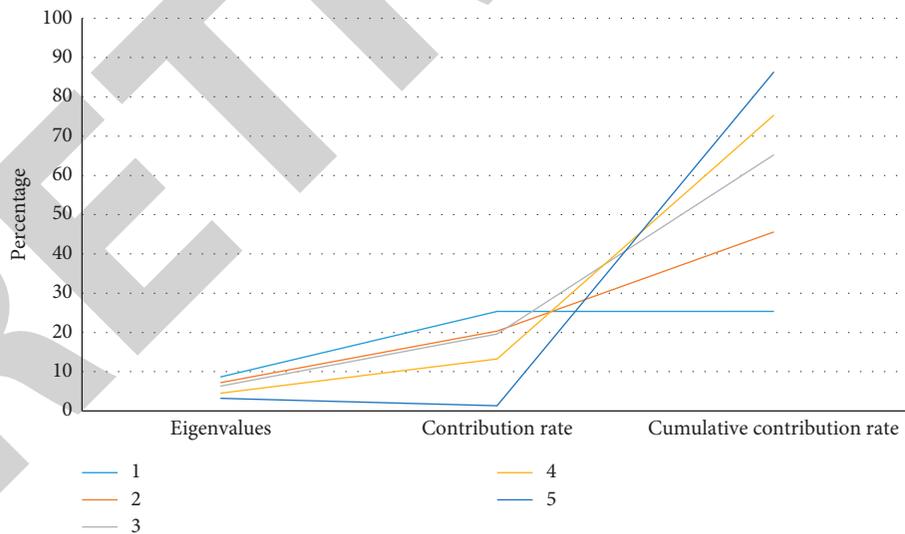


FIGURE 3: A statistical graph of the extraction results of factor analysis in factor analysis.

severity, and controllability to score. The scores of the three indicators are multiplied to obtain the risk. The method for evaluating the risk factors of sports injury is $RV = P \cdot S \cdot C$, where P represents the probability of occurrence of the risk, S represents the severity of the occurrence of the risk, C

represents the controllability of the occurrence of the risk, and RV represents the amount of risk [25].

According to the qualitative analysis method, the risk of each factor risk factor is evaluated, and the evaluation uses a five-level qualitative quantification table (Table 4).

TABLE 4: Evaluation statistics table of five major risk factors ($n = 12$).

Major risk factors	Possibility	Severity	Controllability	Amount of risk
F1	3.29	3.21	2.82	27.82
F2	3.02	3.15	2.62	17.65
F3	2.95	3.01	2.95	24.52
F4	3.06	2.39	2.93	21.36
F5	2.64	2.32	2.13	11.25

Through the evaluation of the five risk factors obtained, it is understood that in tennis, the factors that cause sports injuries are sports technical factors, sports physiological factors, sports psychological factors, sports training factors, and environmental factors [26].

It can be seen from the above table that the sports technique factor is the largest factor that causes sports injuries in tennis events. According to Tian Maijiu's event group training theory, the tennis event belongs to the skill-led category of difficult-to-beauty sports events. In order to create good sports performance, continuous innovation in movement is difficult, which brings a huge risk of sports injuries to athletes. Athletes' lack of understanding of technology and complex movements themselves are also more likely to cause sports injuries. Physiological factors are the second most important factor affecting tennis players. In terms of physical fitness and stamina, any sport has a corresponding special physical fitness. To a certain extent, the good performance of technology requires good physical fitness. Tennis events require explosive power, absolute strength, strength endurance, movement speed, speed endurance; flexibility, agility, coordination, vestibular function, and so on. All aspects of physical fitness required by tennis are strict requirements for athletes. Failure to achieve specific physical fitness will seriously affect the sports technique. In normal training, it is often the case that learning a certain sports technique causes sports injuries due to insufficient physical fitness. Injuries and heart and lung functions are the factors that affect physiological factors and must be strengthened and improved in a targeted manner. Once the athlete's psychology has even minor changes (athletes worry, lack of concentration, hesitation in doing actions, and high pressure), it can affect the performance of sports skills and even cause accidents and sports injuries. Therefore, psychological factors are also a major hidden danger that causes sports injuries for tennis players. Sports training has a direct relationship with coaches. A good coach is a magic weapon for athletes to reduce the occurrence of sports injuries. Therefore, we must pay attention to the training ability of coaches and the promotion of theoretical knowledge.

In tennis events, due to the controllable external environmental conditions, it does not have a direct effect on athletes' sports injuries. However, it is also an indispensable routine task to strengthen the security inspection of the venue and the monitoring of the venue environment. In short, if tennis players want to reduce the occurrence of sports injuries during training or competition, the above-

mentioned aspects must be considered thoroughly, so as to provide players with a good safety environment and make contributions to my country's tennis career.

3.6. Sports Injury Risk Early Warning Process. Sports injury early warning includes the main steps of model initialization, attribute discretization, attribute reduction, sample extraction, and RBF learning. The specific process is shown in Figure 4.

From Figure 4, we can know to

- (1) Use the dynamic chain model factor of the sports injury early warning factor to determine the sample early warning and test sample database of the sports injury risk
- (2) Identify the data crisis corresponding to the sample library project; if it is not discrete, the discrete SOM neural network method is called to separate the factor data, and the discrete factor data is used after the SOM neural network to create a separate comprehensive decision table
- (3) Follow the simplification process of RS theory, simplify the decision table and its functions, extract the rules, and create an RBF neural network based on the simplified decision table
- (4) According to the simplified decision table, select the corresponding data in the sports injury library and train the early warning samples until the RBF neural network converges and meets the accuracy requirements
- (5) Use the test sample data to determine whether the diagnostic result of the trained RBF network is correct; if not, please select another reduction result in (3) and then scroll to (4) until you download the trained neural network sample library
- (6) Use the well-trained RBF neural network to evaluate the relevant information submitted by the athletes and generate the correct risk warning results

4. Results and Analysis

4.1. Status Quo of Sports Injuries of Young Tennis Players

4.1.1. The Incidence of Tennis Injuries. A survey of 48 tennis players of different ages concluded that all 48 tennis players suffered various degrees of sports injuries, with an injury rate of 100%. Since participating in formal training and tennis competitions, 15 young tennis players have been injured more than 6 times, accounting for 31.2% of the total; 20 have been injured 3–6 times, accounting for 41.7% of the total; and 9 have been injured several times, accounting for 18.8% of the total; and 4 have been injured, accounting for 8.3% of the total (Figure 5). A total of 170 people have been injured, with an average of 3.5 people injured per school. It can be concluded that sports injuries are more common among Chinese tennis players and should be noted.

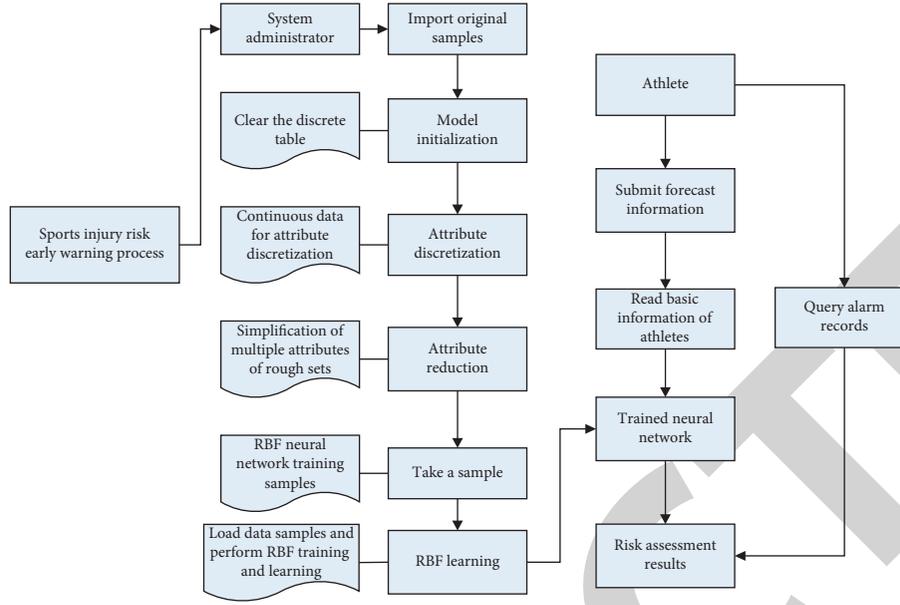


FIGURE 4: Early warning flow chart of tennis sports injury.

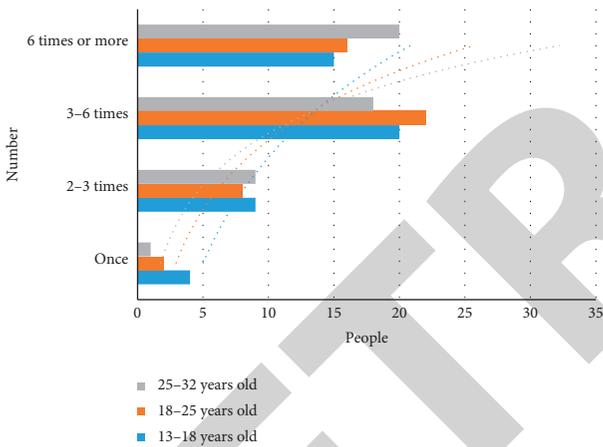


FIGURE 5: Distribution of sports injuries in different age groups.

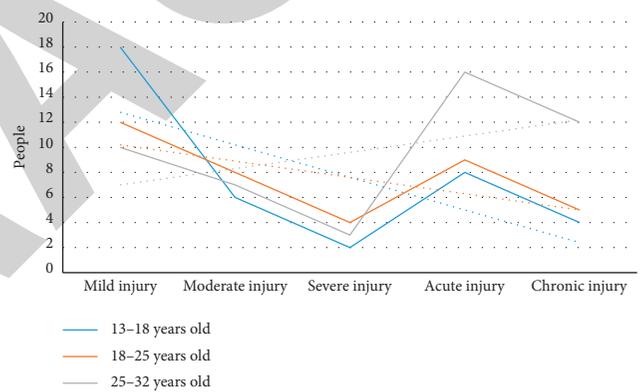


FIGURE 6: The distribution of sports injuries in different age groups.

4.1.2. *The Nature of Sports Injuries.* Injury can be divided into mild injury, moderate injury, and severe injury, depending on the degree of loss of sports ability after sports injury. Among the 48 tennis players of different ages with sports injuries, 33 were slightly injured, accounting for 68.7% of the total; 13 were moderately injured, accounting for 27.1% of the total, and 2 were seriously injured, accounting for 4.2%. Among the 48 athletes, 41 were seriously injured, accounting for 85.4% of the total number of injuries, and 7 were long-term injured athletes, accounting for 14.6% of the total number of injuries. The data is shown in Figure 6.

4.2. *Preventive Measures for Sports Injuries of Young Tennis Players.* By consulting a large number of literatures on preventive measures for sports injuries of tennis players, and according to the results of expert interviews, this article lists

11 preventive measures for sports injuries of young tennis players in the questionnaire, and each preventive measures are classified as “particularly important”, “important”, and “general”; these three levels of influence are requested by coaches to make an evaluation. The evaluation results are shown in Table 5.

It can be seen from Table 5 that the top five preventive measures for “particularly important” frequencies are: providing scientific training and reasonable exercise load arrangement, focusing on strengthening the quality training of vulnerable parts, improving the quality of training and prematch preparation activities, strengthening special technical training and correcting and standardizing technical movements, and improving the concentration of training and competition. With reference to the evaluation results, combined with the characteristics of young tennis players’ sports injuries and injury factors, this article analyzes the above five preventive measures in detail from the perspective of training.

TABLE 5: Survey results of preventive measures $n = 10$.

Sort	Precaution	Particularly important frequency	Important frequency	General frequency
1	Providing scientific training and reasonable arrangement of exercise load	8	2	0
1	Focusing on strengthening the quality training of vulnerable parts	8	2	0
3	Improving the quality of preparation activities	7	3	0
3	Strengthening special technical training	7	3	0
3	Improving concentration in training and competition	7	3	0
6	Attaching importance to relaxation and recovery after training and competition	6	2	2
7	Strengthening self-protection awareness	5	4	1

5. Conclusions

Based on the analysis of track and field sports injury factors, an intelligent early warning model based on RBF neural network is proposed. After the test of the test library, the RBF neural network algorithm has obtained relatively ideal results, which can provide early warning of the risk of sports injuries. After many recent sports injury cases, the accuracy of the neural network model RBF evaluated the neural network. It has been further improved. Therefore, the algorithm is very suitable for reminding athletes of the risk of sports injuries. Sports injuries are common among young tennis players. According to the characteristics of sports injuries and the injury factors of young tennis players, it can be concluded that the main measures to prevent sports injuries are providing scientific training and reasonable exercise load, focusing on improving training level to strengthen the vulnerable parts, improving training and the quality of prematch preparation activities, strengthening special technical training and correcting and standardizing technical movements, and improving training and competition concentration. Due to limited research time and funds, the establishment of a large sample training database remain a difficult task. This directly affects the accuracy of the system in assessing athletes' sports injury risks. This is the direction of the next step. Due to the diversity of training data collection and the uncertainty of training time and space, the existing training information management based on a nonmobile computing environment has brought great limitations to users, and it is difficult to achieve real-time training information anytime, anywhere; management; and monitoring.

Data Availability

No data were used to support this study.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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