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Article

A study on modeling and simulation of sports training injury optimization from a biomechanical perspective

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Abstract: With the advancement of artificial intelligence technology today, sports training is one of the key methods for maintaining personal health. Reasonable sports training contributes to both the happiness and the physical well-being of athletes. However, because the intensity of sports training is greater than the physical endurance, it may lead to physical injury. The sports training injury model can collect the physical data of athletes, and simulate whether the actions that athletes want to practice are standard and correct through the collected data. If there are errors in the simulated exercise actions, the wrong exercise actions can be corrected in time, so as to reduce the incidence of sports injury accidents. Constructing the experimental model and analyzing the data involved are highly complex tasks; existing simulation models struggle to meet these challenges, significantly impacting the future development of such models. In view of this phenomenon, this paper, on the basis of the sports training injury model, combined with the neural network method, conducted an effective research on the construction of the sports training injury model, and inspected the performance of the model by testing the accuracy of the evaluation of the injury risk level, the degree of sports training injury, and the accuracy of the evaluation of the prediction results of the sports training injury model. The experimental data shows that the maximum accuracy of the sports training injury model in the horizontal and vertical directions was 94.43% and 95.26% respectively, and the maximum accuracy of the single injury degree and the composite injury degree was 48.68% and 55.01% respectively, which had high accuracy and operational efficiency, and can effectively avoid the occurrence of training injury.

Keywords: artistic intelligence; sports training income; neural network; prediction model

1. Introduction

With the vigorous development of artificial intelligence technology, machine learning has been derived. Neural network is the most widely used in the field of machine learning. Neural network is a highly parallel information processing tool that can handle complex nonlinear systems. No matter in sports competitions or in ordinary life, people would do some sports training in order to keep their physical functions strong. Due to people's limited cognition, injuries may occur in the process of sports training due to excessive exercise load or incorrect actions, and then have an impact on people's continued movement. With the further development of multi-layer perceptive neural network technology, relevant body function data are collected for research objects, and simulation models are established on the basis of various data, so as to avoid sports injuries in sports training.

In recent years, because people's sports training is more and more frequent, in order to protect people's health, the simulation construction of sports training injury model has become the need of practical development. Davis proposed that the severity of athletes' foot injuries has a significant impact on whether they can return to the competition venue. In order to reduce similar sports injuries, the athletes' foot injuries were examined and analyzed to facilitate the evaluation of the injured part [1]. Zhu proposed that after the depth based learning technology was integrated into the sports auxiliary system, when the sports auxiliary system was introduced into sports training, the training process of athletes can be monitored through sensor equipment to help athletes analyze technical actions, so as to avoid injuries during sports training [2]. Krsti proposed that the routine partner in sports activities is sports injury, and the severity of sports injury depends on the type of sports activities involved. If athletes want to successfully return to the stadium, it depends on early treatment [3]. Lauersen proposed that children and adolescents' active participation in sports can prevent many diseases, and the treatment process of sports injuries is very troublesome and time-consuming. In order to effectively prevent adolescents from sports injuries, they can intervene with external risk factors [4]. Kerr proposed a sports injury detection system that can detect concussion. The system focuses on tracking concussion occurrence data and reminding the system user [5]. Taddei put forward that running injury has become a common dangerous phenomenon, which has interrupted many runners to participate in this healthy sports. In order to reduce running injury, a new type of foot strengthening scheme has been explored [6]. Kerr proposed that the injury rate of sports training in college campus is higher than that in high school campus, and the injury rate in competition is higher than that in practice. Concussion is one of them, which also confirms the need to develop effective interventions to reduce the incidence rate and severity of concussion [7]. Baker proposed that the incidence of injuries in sports training has nothing to do with the growth of age. Through linear regression and logical regression analysis, it can be determined that athletes who have participated in cross training activities would effectively reduce the incidence of sports injuries [8]. While previous research has yielded positive outcomes, given the rising incidence of sports injuries, there is a need for more effective construction of sports training injury models. The construction of sports training injury model based on multi-layer perceptual neural network technology can achieve this development demand. Multilayer perceptual neural networks have been widely used in pattern recognition and risk prediction. Yue proposed that since most of the sports training is not related to the teaching system, in order to ensure that the quality of sports training and teaching can be maximized, an online sports training and teaching system based on BP neural network has been established [9]. Xu proposed that in order to prevent injuries in sports training, he studied a sports training video sorting model based on multi-layer perception technology, selected the designated sports training videos, so that athletes can master the correct training actions as soon as possible [10]. Ge proposed to combine the neural network with the teaching method, so as to use the neural network method to analyze the cause of sports injury in basketball training [11]. Xu proposed a flipped classroom education model based on neural network technology. The emergence of this model has promoted the modernization of sports training education, and has had a positive impact on the sports field [12]. Liu proposed that in order to monitor the health status of athletes and avoid sports injuries, he studied a method based on deep learning and neural network technology to identify athletes and provide relevant quality feedback [13]. On the whole, the multi-layer perceptive neural network technology has developed more maturely in other fields, but it has not been deeply integrated with the sports training injury model. In order to enhance the application value of the sports training injury model, the research on the construction of sports training injury model based on the multi-layer perceptive neural network technology is very important.

In this paper, the construction of sports training injury model is deeply studied with the method of neural network, and the sports training injury model is tested from three aspects: the accuracy of injury risk assessment, the degree of sports training injury and the accuracy of the evaluation of the prediction results of sports training injury model. The test data showed that the maximum test accuracy of the first two types of evaluation accuracy of traditional sports training injury models were 81.35% and 96.41%, and 37.21% and 43.26%, respectively. The test accuracy of the evaluation accuracy of the sports training injury model constructed in this paper is 94.43% and 95.26%, 48.68% and 55.01% respectively. In terms of the evaluation accuracy of the prediction results of the sports training injury model, the traditional sports training injury model has less fluctuations in the evaluation process, which may lead to errors in the final evaluation results of the traditional sports training injury model. The sports training injury model built in this paper fluctuates a lot in the evaluation process, and the final evaluation results would be more accurate, which shows that this model is highly feasible.

This study uses neural network technology to explore the sports training injury model in depth, aiming to improve the accuracy of injury risk assessment in sports training, in order to effectively prevent and reduce sports injuries.The theoretical foundation covers neural network theory, sports injury prevention theory, sports science and biomechanical principles.Specifically, the widely used neural network architecture of multi-layer perceptron (MLP) can handle complex nonlinear relationships and help capture the complex interactions of individual athletes, training intensity and other factors.Sports injury prevention theory believes that through monitoring and analyzing athletes' training data, injury risk factors can be identified in advance and preventive measures can be taken.The principles of sports science and biomechanics help to understand the mechanical mechanisms of the body that may cause injury in sports training.Based on this, this study puts forward three hypotheses: first, the sports training injury model constructed by neural network technology can more accurately predict the potential injury risk in sports training; second, the new model is better than the traditional model in injury risk assessment and injury degree judgment; third, the model can provide athletes and coaches with personalized injury prevention recommendations.

Compared with existing research, this research provides a new perspective.Existing research focuses on specific types of sports injuries, and relies on traditional statistical methods for data analysis.In this study, neural network technology is used to process a large amount of exercise training data, which can find more subtle risk factors and provide more accurate guidance for injury prevention.Through the prediction results of the model, a personalized training plan can be customized for each athlete to reduce injuries caused by excessive or improper training.In addition, the model can not only evaluate past data, but also monitor in real time, adjust the training plan in time, and prevent upcoming injuries.

This study solves the key problems in the existing research: first, the sports training injury model based on neural networks performs better in injury risk assessment and injury degree judgment; secondly, the existing research is mostly limited to specific sports or injury types, and this model improves the adaptability and generalization ability of different types of sports injuries by dealing with a variety of factors; finally, by improving the accuracy of injury risk assessment, this research helps to promote the formulation and implementation of preventive measures and reduce the incidence of sports injuries.

2. Sports training injury modeling

2.1. Overview of sports training injuries

(1) Types of sports training injuries.

In daily life, athletes would engage in relevant sports training in order to maintain their health. When conducting sports training, it is inevitable that sports training injuries would occur. There are many factors that cause sports training injuries. However, when classifying the types of sports training injuries, the main types of injuries can be divided into two categories. Sudden sports training injuries are mainly manifested in various injuries that occur during sports training. Sudden sports training injuries are closely related to the sports training items that athletes participate in. In order to strengthen their physical fitness and achieve the effect of target designation, athletes usually adopt high-intensity training methods. This kind of high-intensity training mode would cause injuries to the muscles or limbs of the athletes, which would increase the probability of injury to the athletes. The main performance of the old sports training injuries is that the athletes have had different injuries in the past sports training. Because the athletes did not pay attention to it or did not take effective measures, the physical conditions have not been completely restored, thus the old injuries induced in the future sports training.

(2) Main causes of sports training injury.

Physical training is a targeted physical training exercise plan to achieve the established sports goals. On the whole, there are many reasons for sports training injuries, which can be mainly divided into three categories: high load sports training, unreasonable links in sports training methods, lack of understanding of self physical quality and high expectations for sports training. High load sports training is mainly due to the fact that the intensity of sports training carried out by athletes exceeds the load intensity that the physical function can bear, so it is easy to appear the phenomenon of overdraft of the physical function, and has brought about a certain degree of damage. There are unreasonable links in the methods of sports training, mainly because the athletes do not combine the physical function and the target quantity of sports training before the sports training, and there is no clear planning, which is prone to injury accidents. For athletes suffering from old secondary injuries, high-intensity sports training at this time may cause more serious injuries to the injured parts when the injury is not fully recovered. Therefore, the subjects of sports training need to be reasonably set up by athletes in combination with the actual situation to avoid the occurrence of sports training injuries. The reason why they do not understand their physical quality and have high expectations for sports training is that the athletes set too high training goals in sports training and did not give consideration to the objectivity of training methods, training plans and physical functions [14].

(3) Preventive measures of sports training injury.

Precise sports training principles to avoid sports training injuries.

In the implementation of sports training, it is necessary to distinguish between general sports training and targeted sports training. In targeted sports training, trainers mainly focus on improving training results, and would strictly divide the training content. In general sports training, there is no strict training plan. Trainers focus on optimizing physical functions, and lay the foundation for targeted sports training. In targeted sports training, trainers need to improve the pertinence of sports training according to the training objectives and methods. Therefore, there are some differences between general sports training and targeted sports training in training objectives, training methods and training plans. General sports training focuses on basic training, while targeted sports training focuses on improving training results. In sports training, it is necessary to formulate corresponding training plans according to different training items and physical qualities of different trainers, and scientifically analyze the endurance limit and training methods of trainers, so as to avoid injury caused by excessive training.

Establishing the Consciousness of Injuries in Physical Training and Reasonably Adjusting the Objectives of Physical Training

In sports training, training injuries exist objectively. For how to make a reasonable training plan, it should consider the physiological age of the trainers, sports training items, training competitive ability and the mastery of tactics, so as to analyze the main causes of training injuries in sports training. Targeted preventive measures shall be taken according to the training intensity, training contents and training methods of the trainers to ensure the orderly implementation of the training plan. In the process of sports training, it is necessary to fully understand the physical conditions and conditions of the trainers, make preparations in the early stage, and avoid the occurrence of training injuries [15].

2.2. Overview of neural network model

The data set contains the feature elements required for building the neural network model. In the interrelated components, the weight is constantly adjusted when the components are related, so as to achieve high prediction accuracy. The neural network structure is shown in **Figure 1**.

In **Figure 1**, there are four input nodes in the bottom input layer, five hidden nodes in the middle hidden layer, and one output node in the top output layer. The focus of the neural network is to adjust the nonlinearities in hidden neurons when adjusting weights.

In this paper, a neural network model containing an input layer, a hidden layer, and an output layer is constructed.The input layer has 4 nodes, which receive data on factors affecting sports injury; the hidden layer contains 5 nodes, which process the data through the activation function and produce a nonlinear output; the output layer gives the final prediction.During training, the gradient descent method is used to adjust the weighting to reduce the error, and the RBF network is used to deal with the classification problem, and the model performance is improved by optimizing the function center and width.

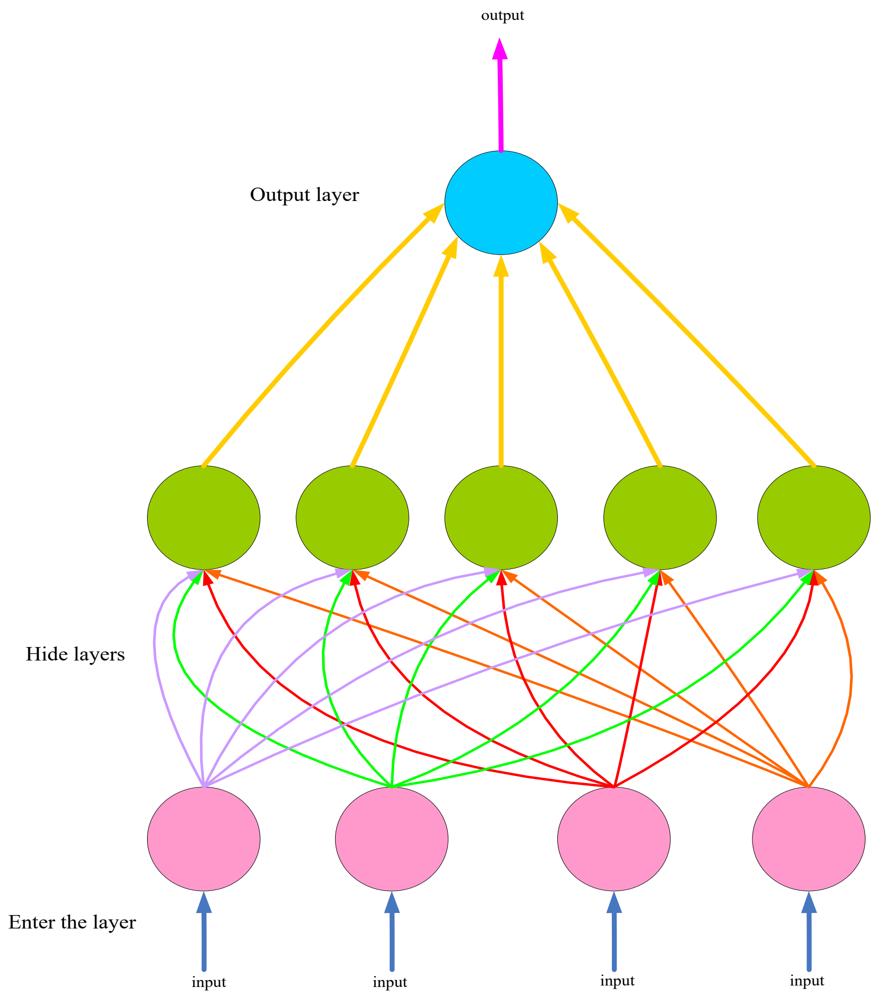

Figure 1. Neural network structure display diagram.

2.3. Establishment of sports training injury model

In order to construct a sports training injury model, this paper collected data on internal and external injury factors of coaches through questionnaires, such as age, exercise level, venue, weather, etc. Hierarchical analysis is used to quantify these factors and clarify their impact on injury. In neural network modeling, the radial basis function network is selected and the parameters are adjusted to improve the prediction accuracy. Finally, by comparing the performance of the new model and the traditional model in terms of injury risk assessment, degree judgment and prediction accuracy, the effectiveness of the new model is verified.

(1) Study on factors of training injury.

The factors that cause training injury are generally divided into two categories, namely internal factors and external factors. There are various reasons that affect the training injury, and each factor has certain interaction. In this paper, data investigation is conducted on relevant factors of training injury of trainers, as shown in **Tables 1–3**:

Table 1. Internal damage factor data statistical table.

Trainer serial number	1	2	3	4	5
age	3	3	4	3	3
Exercise level	4	4	4	3	3
BMI index	3	2	3	3	3
History of injury	1	2	2	2	4
Injury recovery status	2	2	3	3	3
Joint stability	3	3	3	4	4
Joint flexibility	3	3	3	4	4
Contrast of strength between the anterior and posterior thighs muscles	2	2	2	2	2
Thigh left and right circumference contrast	2	3	2	2	3
Body balance stability	3	3	3	4	4
Arch form	2	2	2	3	2
menstrual cycle	0	1	1	2	2

Table 2. External damage factor data statistics table.

Trainer serial number	1	2	3	4	5
Site factors	2	2	2	2	2
Weather, climatic factors	3	3	3	3	3
Whether the training plan is temporarily changed	2	3	3	2	3
Sneaker changes frequently	4	4	4	4	4
There are no protective measures	3	4	4	2	4
Level of technical application	4	4	3	4	4

Table 3. Statistical table of information about the initiators.

Trainer serial number	1	2	3	4	5
Whether the technical action is wrong	2	2	2	2	2
Mental state	2	2	2	3	2
Physical functions	2	2	3	2	4
Subjective fatigue conditions	4	4	4	4	4
The amount of training load	3	3	4	4	2

Different training injury factors have different contributions to training injury. Analytic hierarchy process is used to analyze the coefficients of each training injury factor, so as to determine the data of training injury factors, and then to predict and evaluate the training injury of trainers. According to the analysis results, a value within the standard deviation is taken.

(2) Analysis of sports training injury method based on neural network.

On the basis of neural network, the risk of training injury is distinguished of information. The risk level can be divided into low, medium and high levels. Similarly, the training injury risk of trainers can be divided into three categories, as shown in **Table 4**:

Table 4. A table of comparison of output values and risk levels.

Training injury risk level	The output value of the neural network
Low level risk	0
Medium level risk	1
High level of risk	2

In the construction of neural network, in order to facilitate the calculation of weights between the center, width and output layers of the hidden layer, gradient descent is used to determine [16].

a. Function selection.

Select the hidden layer activation function as the preferred function:

$$G_k(a) = e^{-\frac{\|a-c_k\|^2}{2\sigma_k^2}} \tag{1}$$

In Equation (1), $G_k(a)$ is output as the kth hidden node, a is the input vector of n dimension, c_k is the function vector of the kth hidden layer, and the output in the neural network is defined as:

$$y_k = \sum_{k=1}^{j} w_{ik}\, G_k(a) \tag{2}$$

In Equation (2), $i = 1, 2, \ldots, m$; y_k is the node output value of the output layer.

b. Design of hidden layer.

In this paper, the hidden layer can be determined by a simple method, that is, a risk level can correspond to a function. Similarly, the distance between the three types of sample data and its center point can be used as the width of the function, and then the values of the three types of sample data can be taken as the center of their respective functions.

c. Radial function center, width and value to output layer.

The learning process experienced by the radial function center generally adopts the learning process of error correction. The error function defined for all input samples is:

$$\xi = \frac{1}{2}\sum_{q=1}^{N} e_q^2 \tag{3}$$

where in:ξ—Sum of squared errors.

In Equation (3), e_q is the error, defined as:

$$e_q = d_q - y(a_q) = d_q - \sum_{j=1}^{3} w_{ij}\, G_k(a_q) \tag{4}$$

where in:w_{ij}—Weight;

$y(a_q)$—Obtained by applying weights to radial basis functions.

d. Iterative process of free parameters.

Weight value of output part:

$$\frac{\partial \xi(n)}{\partial w_{1j}(n)} = -\sum_{q=1}^{n} e_q(n)\, G_k(a_q) = -\sum_{q=1}^{n} e_q\, e^{-\frac{\|a_q-c_k\|^2}{2\sigma_k^2}} \tag{5}$$

$$w_{1k}(n+1) = w_{1k}(n) - \eta_1 \frac{\partial \xi(n)}{\partial w_{1k}} \tag{6}$$

Among them, n represents the value range of the current variable, and $n+1$ represents the value range of iterative correction.

Hide cell center:

$$\frac{\partial \xi(n)}{\partial c_k(n)} = -\sum_{q=1}^{n} e_q(n) G_k(a_q) \tag{7}$$

$$c_k(n+1) = c_k(n) - \eta_2 \frac{\partial \eta(n)}{\partial c_k} \tag{8}$$

Width of function:

$$\frac{\partial \xi(n)}{\partial \sigma_k(n)} = -\sum_{q=1}^{n} e_q(n) \frac{w_{1k}(n)}{\sigma_k^3(n)} \left\| a_q - c_k \right\|^2 G_k(a_q) \tag{9}$$

$$\sigma_k(n+1) = \sigma_k(n) - \eta_3 \frac{\partial \xi(n)}{\partial \sigma_k(n)} \tag{10}$$

Among them, η_3 refers to learning efficiency.

(3) Design of injury model in physical training.

On the basis of the neural network model, a new neural network sports training injury model is constructed, and its overall structure is shown in **Figure 2**:

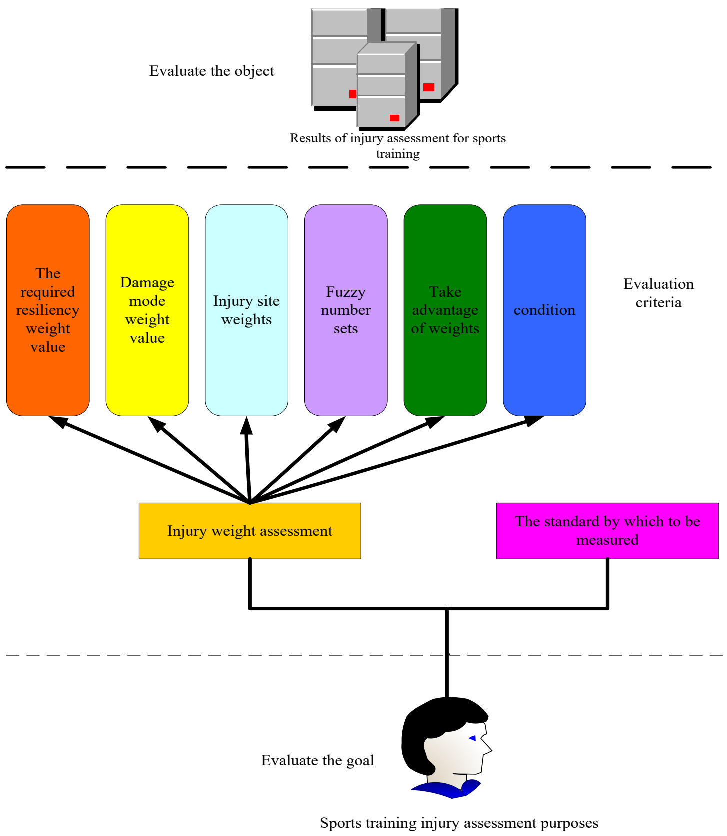

Figure 2. Overall structure diagram of the sports training injury model.

The top level is the evaluation object, and also the degree of sports training injury. The middle layer is the evaluation standard, which determines the comprehensive standard and some factors. The bottom layer is the evaluation result, and the result of neural network analysis can be used as the final result.

In the experimental setting, we first collected data on internal and external injury factors of coaches through questionnaires, such as age, exercise level, venue conditions, weather, etc., and used hierarchical analysis to quantify these factors, revealing their specific effects on sports injuries. Next, we constructed a neural network model that contains the input layer, the hidden layer, and the output layer. The input layer has 4 nodes, which are responsible for receiving data on factors affecting sports injury; the hidden layer has 5 nodes, which use the activation function to process the data and produce a nonlinear output; the output layer is responsible for giving the final prediction result. In order to improve the prediction accuracy, we adopted the radial basis function (RBF) network and optimized the model performance by adjusting the center and width of the function. During the training process, we use the gradient descent method to adjust the connection weight, and strive to minimize the prediction error. At the same time, we set a sufficient number of training iterations to ensure that the model can achieve optimal performance and converge. The learning rate is carefully set and dynamically adjusted according to changes in the loss function during the training process to avoid problems caused by improper learning rate. In addition, we have standardized preprocessing of the data to speed up the training process and enhance the stability of the model. In order to verify the effectiveness of this neural network-based sports training injury model, we designed two sets of computer simulation experiments. Each set of experiments contains comparative tests of the new model and the traditional model. We selected 5 representative participants as samples and recorded key information such as their age, gender, exercise type, exercise years and body mass index in detail. The experimental parameters have been carefully set, including vertical and horizontal damage judgment accuracy, training damage level, network safety factor, evaluation accuracy and damage parameters, etc., to comprehensively and in-depth evaluate the performance of the model.

3. Sports training injury model test

In the experimental test part, two sets of computer simulation experiments were used to verify the effectiveness of the sports training injury model based on neural networks.Each set of experiments includes a comparative test of the newly constructed sports training injury model and the traditional sports training injury model.To illustrate the study sample size and demographic statistics, data from 5 participants were used as samples in the study.The demographic statistics of the 5 participants are shown in **Table 5**:

Table 5. Demographic data table of participants.

Serial number	Gender	Age (years)	Sports type	Years of physical activity (years)	BMI (kg/m^2)
1	Male	25	Basketball	5	22.5
2	Female	30	Swimming	8	24.0
3	Male	28	Football	6	23.2
4	Female	23	Athletics	3	21.8
5	Male	35	Swimming	12	25.5

Among them, the gender sample contained 3 men and 2 women.The age sample covered the age group from 23 to 35 years old.The sample of sports types includes sports types such as basketball, swimming, football, and track and field.The exercise years sample contains 3 to 12 years of exercise years.The BMI sample covers different BMI values from 21.8 to 25.5.

This study collects data provided by coaches through questionnaires, covering the internal and external injury factors of athletes, which is essential for the construction and verification of sports training injury models.The data set contains injury-related factors such as age, exercise level, venue, weather, etc., which are quantified by hierarchical analysis to reveal their impact on injury.These data provide input characteristics for the neural network model to help identify potential damage risks.Although the data set is not large in scale, it is rich in information and reflects the training characteristics and personal differences of athletes in different contexts.In-depth analysis of these data reveals the potential patterns of injury occurrence and constructs a model to predict the risk of injury.The diversity of data sets enhances the generalization ability of the model and makes it applicable to a wider group of athletes.This data set provides a solid foundation for constructing a sports training injury model, not only improves the accuracy of injury risk assessment, but also provides athletes and coaches with personalized injury prevention recommendations, which is of great significance to improve the safety and effectiveness of sports training.

In order to verify the effectiveness of the sports training injury model under the neural network, this paper collocates two computers as experimental objects, dividing into two groups, and loads the new sports training injury model and the traditional sports training injury model, and then adjusts the experimental parameters, as shown in **Table 6**:

Table 6. Experimental parameter table.

The parameter name	Control group	Experimental group
VDJ/%	94.43	94.43
LDJ/%	95.26	95.26
DGD/grade	III	III
NSC	0.64	0.64
AEV/%	93.37	93.37
DPT	8.82×10^7	8.82×10^7

The parameter names in **Table 6** represent the accuracy of longitudinal damage judgment, the accuracy of transverse damage judgment, the level of training damage, the network security factor, the accuracy of evaluation and the damage parameters in turn. Among them, the network security factor in this paper is set as Level III, safety state maintained by training injury model.

(1) Accuracy of risk level assessment of transverse and longitudinal damage.

The comparison of horizontal and vertical damage risk levels is shown in **Figure 3**.

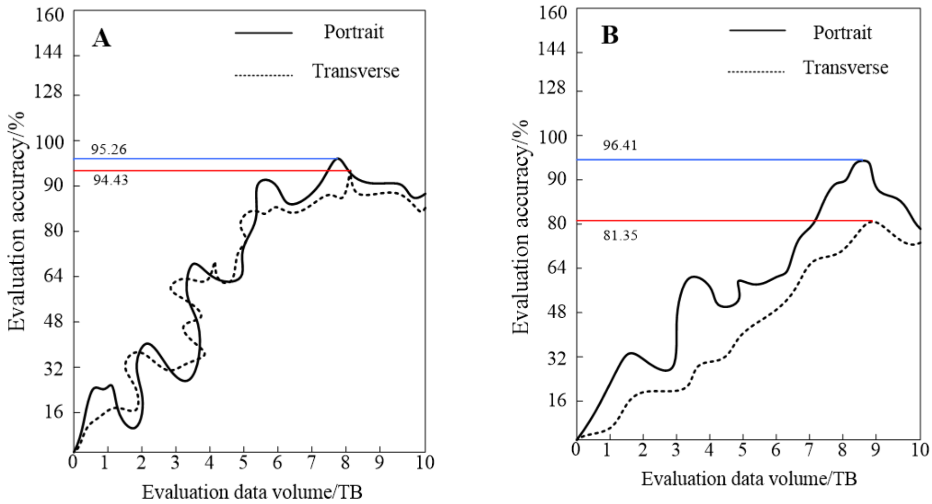

Figure 3. Comparison diagram of risk levels of transverse and longitudinal damage. **(A)** shows the injury model of sports training in this paper; **(B)** shows the injury model of traditional sports training.

Under the simulation effect of the sports training injury model in **Figure 3A**, it can be seen that the accuracy of the horizontal and vertical training injury assessment of the sports training injury model in this paper is relatively small. Whether on the rise or down, the same trend is always maintained. In the traditional sports training injury model in **Figure 3B**, the accuracy of horizontal and vertical training injury assessment is quite different, and the change trend of the two is not always consistent. By comparing **Figures 3A,B**, it can be seen that if the horizontal and vertical training damage assessments are not conducted at the same time, the accuracy of the horizontal and vertical training damage assessments is quite different. In **Figure 3A**, the maximum accuracy of lateral training injury assessment is 94.43%, and the maximum accuracy of longitudinal training injury assessment is 95.26%. The trend of changes between the two is consistent and the difference is small. In **Figure 3B**, the maximum accuracy of horizontal training injury assessment is 81.35%, and the maximum accuracy of longitudinal training injury assessment is 96.41%. Accuracy of the evaluation of the sports training injury model in this paper is higher than that of the traditional sports training injury model, which is suitable for practical application.

(2) Degree of physical training injury.

The comparison of the degree of training injury among different models is shown in **Figure 4 (**see **Figure 4A,B)**.

It can be seen from **Figure 4** that **Figure 4A** can analyze whether the type of injury in a specific part of the trainer is complex or single according to the judgment results. In **Figure 4A**, the maximum values of single damage degree and composite damage degree are 48.68% and 55.01% respectively. In **Figure 4B**, the maximum values of single damage degree and composite damage degree are 37.21% and 43.26% respectively. Because the probability of the analysis results of the traditional sports training injury model in **Figure 4B** is low, it is far less than the prediction results of this sports training injury model in **Figure 4A**, and the prediction results of the traditional sports training injury model in **Figure 4B** are not convincing. Therefore, the probability that the sports training injury model in this paper can judge the training injury attributes of specific parts is higher than that of the traditional sports training injury model.

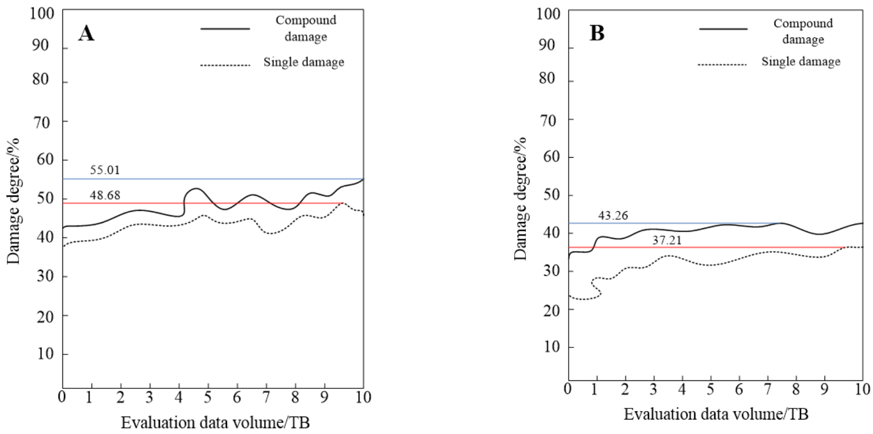

Figure 4. Comparison chart of training injury. **(A)** shows the training damage degree of this model; **(B)** shows the training damage degree of the traditional model.

(3) Evaluation accuracy of prediction results of sports training injury model.

The comparison of sports training injury prediction results of different models is shown in **Figure 5 (**see **Figure 5A,B**).

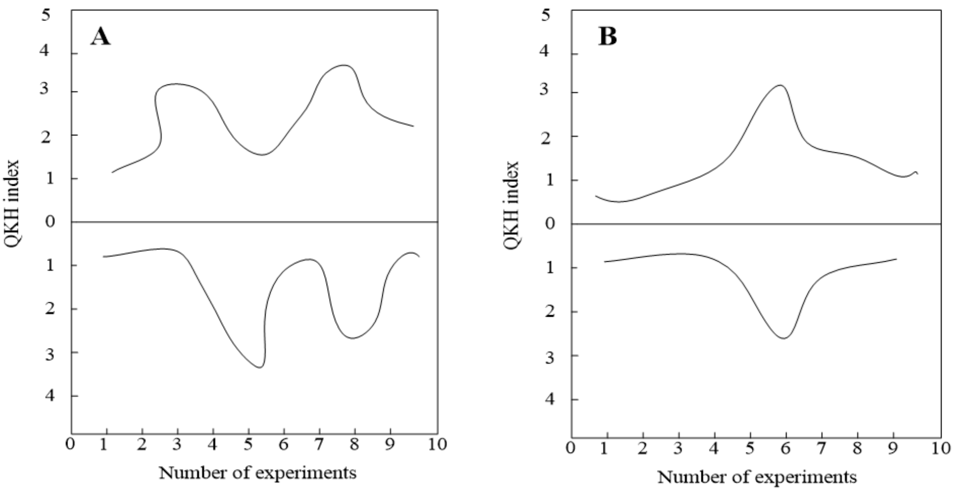

Figure 5. Comparison chart of evaluation methods of sports training injury models. **(A)** shows the prediction result evaluation accuracy of this model; **(B)** shows the prediction result evaluation accuracy of the traditional model.

It can be seen from **Figure 5** that the sports training injury model has a very obvious response to the amount of progress. In **Figure 5A**, the process of evaluation presents a bending amount of progress. Among them, there have been three major transitions, which shows that the sports training injury model in this paper is more accurate in the final evaluation results. In **Figure 5B**, the number of fluctuations in the evaluation process is small, which indicates that the traditional sports training injury model may have errors in the final evaluation results. In combination with **Figure 5A,B**, the evaluation process in **Figure 5A** fluctuates more frequently, while the evaluation process in **Figure 5B** fluctuates less frequently. The accuracy of the results evaluation of the sports training injury model in this paper is better than that of the traditional sports training injury model.

In order to further verify the effectiveness of the newly developed sports training injury model, a control group experiment can be designed to compare the traditional model with the new model.The results are shown in **Table 7**:

Table 7. Comparison results of the two models.

Model type	**Maximum accuracy of lateral injury assessment**	**Maximum accuracy of longitudinal injury assessment**
New model	94.43%	95.26%
Traditional model	81.35%	96.41%
Model type	Maximum accuracy of single damage degree	Maximum accuracy of comprehensive damage degree
New model	48.68%	55.01%
Traditional model	37.21%	43.26%

As can be seen from **Table 7**, the new model has a maximum accuracy rate of 94.43% and 95.26% in the assessment of transverse and longitudinal injuries, respectively, while the traditional model has a maximum accuracy rate of 81.35% and 96.41% in these two aspects, respectively.This means that the new model is about 13 percentage points higher than the traditional model in terms of transverse injury assessment and about 1.15 percentage points lower in terms of longitudinal injury assessment, but overall the new model shows more stable consistency because of the small difference in the accuracy of transverse and longitudinal injury assessment.In the evaluation of the degree of sports injury, the maximum accuracy rate of the new model for a single degree of injury is 48.68%, and the maximum accuracy rate for the comprehensive degree of injury is 55.01%. In contrast, the maximum accuracy rate of the traditional model in these two aspects is 37.21% and 43.26%, respectively.It can be seen that the new model is about 11.47 percentage points higher and 11.75 percentage points higher in the assessment of the degree of single injury and comprehensive injury, respectively.This shows that the new model is not only superior to the traditional model in terms of the accuracy of injury assessment, but also shows a stronger ability to deal with complex comprehensive injury situations.Therefore, the new model provides more accurate and reliable predictions in assessing the risk of injury in sports training.

This study uses neural network technology innovation to construct a sports training injury model, which aims to improve the accuracy of injury risk assessment in sports training in order to effectively prevent and reduce sports injuries.Based on neural networks, sports injury prevention, sports science and biomechanical principles, a multi-layer perceptron (MLP) neural network model is created to predict potential injury risks in sports training.We put forward three core hypotheses: the neural network model can predict the risk of injury more accurately; the new model is better than the traditional model in risk assessment and injury degree judgment; the model can provide athletes and coaches with personalized injury prevention recommendations.

Technically, we collected comprehensive data including basic athlete information, training intensity, frequency, and historical injuries through questionnaires, and pre-processed it to ensure the accuracy of the data.We constructed a neural network model with input, hidden, and output layers, in which the hidden layer is activated by radial basis function (RBF) to handle complex nonlinear relationships.Model training uses gradient descent method to adjust the weights to minimize prediction errors.We set the initial learning rate to 0.01, and dynamically adjusted according to the change in loss, and the training iterated for 500 rounds.At the same time, we divided the data set and kept part of it as a verification set to optimize the model parameters and prevent overfitting.

In this paper, the research uses neural networks to construct a sports training injury model, which accurately predicts the potential injury risk.Compared with existing studies, the prediction accuracy of this model has been significantly improved, with the accuracy rates of horizontal and vertical injury assessment reaching 94.43% and 95.26%, respectively, and the judgment of the degree of single and comprehensive injury is also more accurate.In addition, the model can provide each athlete with personalized injury prevention recommendations to help develop a more reasonable training plan and reduce injuries.Importantly, this model is not only suitable for specific sports or injury types, but can be widely adapted to different sports scenes, improving the generalization ability.These findings verify the effectiveness of the model, challenge existing research hypotheses, and provide strong support for improving the safety and efficiency of exercise training.

The neural network motor training injury model constructed in this research has great application potential in the real world. It is widely used in actual sports training.In professional football training, coaches can use this model to comprehensively evaluate players' injuries, training and venue factors, predict the risk of injury, and adjust the training plan accordingly to reduce the probability of injury.In marathon training, the model can monitor the status of runners and provide real-time feedback to help adjust the training intensity and prevent injuries.In rehabilitation training, injured athletes can formulate personalized rehabilitation plans based on the evaluation results of the model to resume training safely and efficiently.This model not only helps coaches and athletes prevent injuries, but also guides rehabilitation and improves training safety and efficiency. By improving the accuracy of injury risk assessment and degree judgment, the model can provide coaches and athletes with accurate prevention recommendations.It can help coaches formulate reasonable training plans to avoid injuries caused by excessive or improper training, and monitor the status of athletes in real time, give early warning, and take timely measures to avoid injuries.At the same time, the model can also guide training during the rehabilitation process to ensure the safe and effective recovery of athletes.

The sports training injury model in this study can be transformed into practical tools, such as mobile applications or online platforms, which are convenient for coaches, athletes, etc. to enter basic information, training intensity, historical injuries and other data, automatically analyze and provide risk assessment and prevention recommendations.The tool can also monitor in real time, collect data through wearable devices, adjust training in time, and reduce the risk of injury. However, there are risks in practical applications, such as data privacy, model generalization, and acceptance of new technologies.In order to deal with these, it is necessary to ensure that the data is legal, encrypted and protected; through continuous data collection and analysis, optimize the model to improve its applicability; strengthen communication with athletes, improve awareness and trust in new technologies, and hold seminars or training to popularize the advantages of this tool. Through these strategies, the neural network motor training injury model can be ensured to maximize its effectiveness in practical applications.

In order to ensure that this model is successfully adopted by coaches, athletes, etc., and coordinated with existing policies and regulations, measures need to be taken.First of all, users should be cautious about possible new technologies, and should provide training and support through seminars, online courses, etc. to help them master new tools.At the same time, well-known people are invited to share their experience and improve their acceptance.Secondly, cooperate with sports organizations and departments to ensure that the tools comply with policies and regulations, and adjust appropriately to integrate into the existing training system, such as negotiating with regulatory agencies to ensure privacy compliance and compatibility with the health system.Finally, establish a feedback mechanism, collect user opinions, and update optimization tools regularly to ensure effectiveness and reliability.Through these measures, technology can be smoothly incorporated into daily training to improve safety and efficiency.

Finally, the model in this article will have a long-term impact, not only to improve training methods, but also to have a positive impact on the health management and performance of athletes.As technology is adopted, training will be more personalized and scientific, reducing injury rates and improving performance.Real-time monitoring and personalized recommendations make health management more refined and help extend careers.In order to ensure the continuous optimization of the model, a feedback mechanism can be designed, user opinions can be collected through applications or platforms, and updates can be released regularly to improve the accuracy and practicality of the model.This will promote the safer and more efficient development of sports training.The specific content of the feedback mechanism is shown in **Table 8**:

Table 8. Content of the feedback mechanism.

Serial number	Feedback category	Problem example
1	User experience	1. Do you think the interface of the tool is friendly?
2		2. What difficulties have you encountered in the process of using it?
3	Functional	3. Are the predictions provided by the tool accurate?
4		4. Do you feel that certain features or features are missing?
5	Practicality	5. Is the personalized prevention advice provided by the tool helpful for your training?
6		6. Have you adjusted your training plan according to the recommendations of the tool?
7	Technical support	7. Do you need technical support?
8		8. Are you satisfied with the technical support provided?
9	Other suggestions	9. Do you have any other suggestions or feedback?

4. Conclusions

On the basis of neural network model, this paper builds a model that can predict sports training injury. It shows good operation efficiency and accurate prediction results in the accuracy of training injury risk level evaluation, the degree of training injury and the evaluation of training injury results, thus effectively avoiding the occurrence of training injury accidents for trainers. At the same time, it can correct the trainers' incorrect actions in the training process, and remind the trainers of the limits of their physical functions. The neural network sports training injury model studied in this paper has obvious advantages in improving the accuracy of injury risk assessment and degree judgment. However, the research also has limitations, which points to the future research direction. The data set is small, containing only a sample of five participants. Although it covers a variety of sports and years, it is more diverse and improves the generalization of the model. Therefore, in the future, the data set should be expanded to include more background athlete data to enhance the reliability and scope of application of the model. Although the model prediction is accurate, real-time monitoring and feedback need to be strengthened. In the future, it can be explored to integrate the model into the real-time monitoring system to provide instant feedback to help coaches and athletes adjust their training plans to reduce the risk of injury. The current research focuses on injury prevention, and there is insufficient discussion on the rehabilitation process. In the future, the application of models in rehabilitation training can be studied to provide personalized programs to help athletes recover to their best condition faster.

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