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Research Article

Sports Injury Risk Prevention and MRI Image Performance of Athletes in Physical Education

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In order to effectively prevent athletes' injury during sports training in physical education, a method of risk prevention of sports injury based on MRI technology was proposed. This method solves the problem of injury prevention in sports training by studying the association analysis algorithm in data mining technology and the research of MRI technology. The experimental results show that the average prediction error of CT and US is about 5%, so it can be considered that the model can predict accurately. *Conclusion*. The method of risk prevention of sports injury based on MRI technology can effectively prevent the injury of athletes in the process of sports training and reduce the injury rate of athletes.

1. Introduction

In order to better play their own strength in the training process, athletes often exert too much force, which will cause the occurrence of sports injury. Sports injury caused by athlete training is often a convoluted complex, and such sports injury is generally accompanied. Players need rehabilitation training; light weight sports injury can cause sports career to come to an end. Many excellent athletes because of injury had to say goodbye to the sports career ahead of time. It can be said that sports injury has become a problem that many athletes have to face. Therefore, the athlete injury prevention is very important in the process of movement [1].

Medical imaging is a device-dependent discipline. Medical imaging equipment, especially CT MR equipment, is driven by the most rapid and cutting-edge technology in natural science and is developing at a veritable speed with each passing day [2–4]. At each stage of the development of medical imaging, it will have an important and sometimes epoch-making impact on other clinical disciplines closely related to it. Currently, the development of medical imaging represented by the development of CT MR technology is in such a stage. Among them, data mining technology plays an important role in medical imaging [5]. Nuclear magnetic resonance (NMR) refers to an atomic nucleus with a fixed magnetic moment, e.g., ^{1}H and ^{13}C. Under the action of constant magnetic field and alternating magnetic field, the phenomenon of energy exchange with alternating magnetic field is a quantitative effect of interenergy level transition, which is a new discipline that emerged in the late 19th century. Nuclear magnetic resonance phenomenon was first introduced by Hamdi and Benamira, independently observed by different methods in different laboratories at about the same time [6]. They made outstanding contributions to the research and development of nuclear magnetic resonance technology, for which they shared the Nobel Prize in Physics in 1952. From the beginning of these two classical nuclear magnetic resonance experiments, nuclear magnetic resonance technology soon received people's attention. With the progress of electrical technology and computer technology, NMR and MR1 technology also got rapid development [7, 8]. At present, nuclear magnetic resonance (NMR) technology is widely used in the study of hydrogen, and two important applied disciplines, NMR spectroscopy and NMR imaging, are generated on this basis. Figure 1 is the flow chart of data mining in NMR technology.

Based on this, through the analysis of injuries that occurred in sports training and prevention of them through medical imaging technology, this paper mainly focuses on

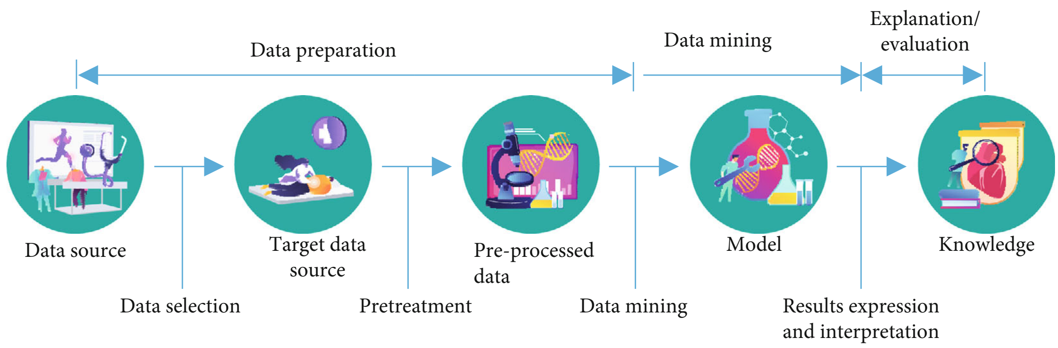

Figure 1: Data mining process.

MRI technology to discuss injury prevention, which can effectively prevent athletes from injury in the training process.

2. Literature Review

Sports injury refers to the occurrence of various traumatic sports injuries in the process of sports and sports events closely related to the technical movements, such as basketball and football which easily injured ankle joints and tennis, badminton, and table tennis that easily hurt the shoulder and elbow. Sports injury in severe life-threatening injury does not see more, a lot of damage to the skin, abrasions, and mild muscle and subcutaneous tissue contusion ligaments and tendons. Some sports injury prevention has more difficult projects, such as Sanda kickboxing and boxing, and some other body against fierce project sports injury is a minor injury or chronic injury; treatment with massage therapy is given priority [9, 10].

The physical condition of adolescent sprinters is an important factor of uneven sports injury degree. To be specific, there is a certain difference in the development of thigh muscle group and leg muscle strength of adolescent sprinters. The sprinters who have good coordination of thigh muscle group and can effectively balance the strength of leg flexor and extensor muscle will have a lower probability of sports injury. In addition, teenage sprinters also have their own exercise habits and muscle frequency in terms of pace adjustment and explosive performance. If the pace is unstable or the pace range is too large, the flexibility of the muscles cannot be reflected, and the strength borne by the tendon and the leg muscles is difficult to balance. The probability of muscle strain increases, and the athletes are more likely to suffer from sports injury [11]. Step by step, strengthen the physical performance of various functions, and do a good job of sprint sports competition before the preparation [12]. Strengthen the training of scientific development, in the process of game training teenager sprinter to their body function index to conduct a comprehensive evaluation, value of the power of their muscles and joints, and the stress range accurately, and then in view of the weak item for centralized training, strengthen the functional performance of the body, in order to better meet the requirements for sprint sports competition [13].

Nuclear magnetic resonance spectroscopy is a subject developed on the basis of magnetic resonance, which is mainly used in the study and analysis of the structure of various substances. It is also one of the most widely used fields of nuclear magnetic resonance technology at present [14]. Nuclear magnetic resonance (NMR) technology is divided into continuous wave NMR and pulsed NMR. The continuous wave NMR method uses the radio frequency field to continuously affect the nuclear system to observe and check the absorption of radio frequency energy or the resonance induction signal of the nuclear magnetization vector. Pulsed NMR method is used to observe the response signal of the nuclear system to the rf pulse in a narrow pulse mode, by induction attenuation signal (FID). From the advent of the first megahertz continuous wave commercial NMR spectrometer in 1953 to the widely used Fourier transform NMR imager, NMR technology has undergone a transformation from continuous wave to pulsed Fourier transform [15]. In particular, pulsed Fourier transform NMR spectroscopy was developed in 1966. This revolutionary leap enabled the development of high-resolution NMR spectrum and made the observation of the natural low abundance of nuclear become a reality, so that the solid NMR technology also developed [16].

In 1973, Stony Brook State University invented spatial coding with linear gradient magnetic field and obtained NMR images from experiment for the first time, thus generating another branch of nuclear magnetic resonance technology—nuclear magnetic resonance imaging (MRI). At present, MRI has developed into a powerful tool in medical diagnosis. In 1975, multidimensional NMR spectrum methodology theory was proposed, which also laid a new theoretical and experimental foundation for NMR imaging. NMR-CT was developed as "Fourier imaging," making NMR imaging different from CT and named as MRI [17].

Data mining is a process of extracting potentially useful information and knowledge hidden in a large amount of incomplete noisy fuzzy random actual application data, which is generally composed of data preparation stage, data mining stage, and result expression and interpretation stage. The data preparation stage can be further divided into data integration, data selection, and data preprocessing. The stage of mining operation includes determining the target of data mining and selecting appropriate tools to excavate knowledge and confirming the discovered knowledge. The task of the result expression and interpretation stage requires not only to express the result but also to filter the information. If the result is not satisfactory to the decision maker, the above data mining process should be repeated.

Based on the above research, MRI technology of injury prevention in athletes' sports training is deeply discussed and studied in this paper, and the occurrence of athletes' sports injuries can be further prevented by using data mining technology and MRI technology.

3. Research Method

3.1. The Specific Process of Data Mining Technology

3.1.1. The Association Rule Algorithm. Association rules are used to screen out the frequency relationship of data item sets in transaction database from a set of given data items and transaction database (each transaction is a collection of data items) and find the valuable correlation between data item sets in a large number of data. When mining association rules, various events in database data should be regarded as data items, and multiple data items constitute the item set of a particular thing. For example, in the medical image database, for the event of patient treatment, each examination item in the process of treatment constitutes its data item set. Microsoft association rule algorithm belongs to Apriori rule algorithm series, which can be divided into two steps: One is to find all frequent item sets whose support is greater than or equal to the predefined minimum support threshold; the other is to generate strong association rules satisfying the minimum confidence from frequent item sets.

3.1.2. Data Preparation. Due to the lack of necessary data verification during the migration of data use and maintenance for many years, as well as the gradual online of the functional modules of the image information system software, and the human error of the data input by the staff, repeated data loss, incompleteness, and error may result. Therefore, in order to ensure the quality of data, it is necessary to process the data. EISStudies and EISService of the RIS database of a hospital have recorded the information of examination items of hospital patients since 2005, from which the basic attributes of patients (number, name, gender, date of birth, etc.) are extracted. A new table was established for patient types (physical examination, outpatient, emergency, and hospitalization) and examination items (number, name, type, etc.). Due to the irregularities in the original entry of examination items, the same examination item has different numbers and names. For example, (X-ray (digital) chest radiography (orthographic)CR) and (X-ray (digital) chest radiography (orthographic)CR) are the same examination item. In order not to affect the analysis results, the examination items should be standardized and unified.

3.1.3. Frequent Item Sets and Association Rules. The primary task of the association rule algorithm is to mine frequent item sets. In order to obtain useful item sets and rules and reduce the model processing time due to the large number of patient examination items, the minimum-support parameter is set to 0.03; that is, only items with a frequency of no less than 3% are selected to generate association rules [18]. Figure 2 shows the generation process of frequent item sets.

According to the generation process of the above frequent item sets, the model generates association rules

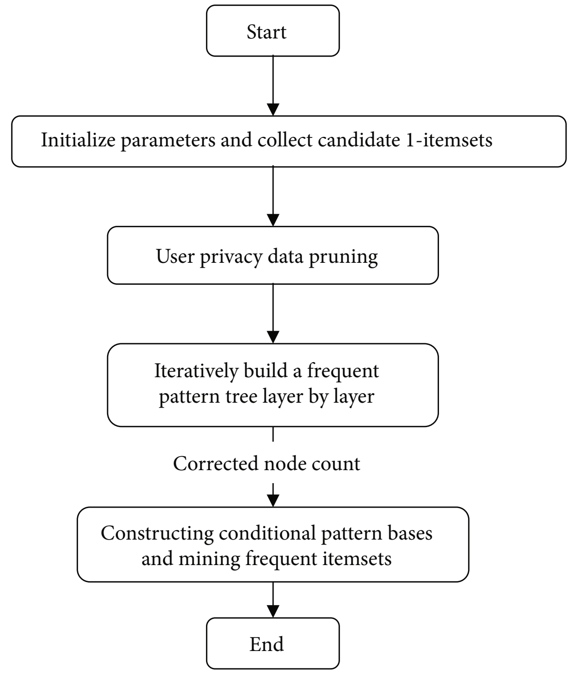

Figure 2: The generation process of frequent item sets.

(see Table 1), where the confidence refers to the probability of the occurrence of result B in the case of condition A. Importance refers to the logarithm of the proportion of the probability of outcome occurrence when the condition is established and when the condition is not established. The importance score is greater than zero, indicating that the rule is meaningful, and the larger the score is, the more significant the rule is. As can be seen from Table 1, in the physical examination items, the probability of patients receiving color ultrasound B (kidney, ureter, bladder, and prostate) and color ultrasound A (liver, gallbladder, spleen, and pancreas) was 98.2%, and the importance score of rules was 1.157. In hospitalized patients, the probability of simultaneous thoracotomy DR with the LEFT and right deep venous US was 73.1%, and the importance score of this rule was 2.867. It can be found that patients with physical examination have a high degree of confidence, which is consistent with the actual situation that patients with physical examination will do some examination item combination packages. However, for patients with door and emergency treatment, due to the uncertainty of examination items, the confidence degree of rules is generally not as high as that of physical examination.

Through association rule analysis, the correlation degree of examination items in patients' medical treatment can be found. If further combined with the disease type of patients, it can provide a basis for hospital clinical path management.

3.2. Equipment Inspection Quantity Forecast

3.2.1. Time Series Algorithm. The Microsoft sequential algorithm encapsulates two different computer learning algorithms. The first algorithm is the automatic regression tree (ART XP) using crossprediction, and the second algorithm

Table 1: Table of association rules.

Patients with type	Generated association rules	Confidence coefficient (%)	Importance
Physical examination	Color ultrasound B (kidney, ureter, bladder, prostate) color ultrasound A (liver, gallbladder, spleen, pancreas)	98.2	1.157
Be hospitalized	Deep vein US of left and right lower limbs→pereon DR	73.1	2.867
Emergency treatment	The four limb CR, plain scan of the liver, gallbladder, spleen, and pancreas→head CT plain scan	66.4	1.512
Outpatient service	Chest DR, arms, ureter, bladder, prostate→liver, spleen, and pancreas	73.2	1.101

is the automatic regression integrated with moving mean (ARIMA). By default, the Microsoft sequential algorithm combines the advantages of the two algorithms to achieve optimal prediction results [19].

3.2.2. Time Series Model Establishment and Verification. The modern imaging department has a large number of MRI digital imaging equipment, such as CT MR, CR, DR, and DF. Monthly inspection quantity of each equipment type is extracted and collected from an original item information table (EIS Service) of the RIS or PACS database, and the equipment monthly inspection scale is designed for the establishment of a timing model. Since the data in the new table has been processed without missing values and the data is summarized and recorded on a monthly basis, the sequence period is set to 12. Figure 3 is the flow chart of the timing model.

3.2.3. Comprehensive Prediction. In statistics, multiple index systems are generally used for comprehensive prediction to improve the accuracy of the check quantity forecast [20]. Here, comprehensive prediction of examination volume in 2012 is made according to the two index systems of patient type and equipment type. Since the time series algorithm is adopted for the examination volume prediction of the two index systems, it is assumed that the importance of the index system is the same, and the equal weight averaging method can be adopted to determine the weight of 0.5, as shown in Formulas (1), (2), and (3).

$$Q_1 = Q(A\,\text{medical}) + Q(\text{in the hospital}) + Q(\text{the emergency department}) + Q(\text{outpatient service}), \tag{1}$$

$$Q_2 = Q_{CT} + Q_{US} + Q_{CR} + \cdots + Q, \tag{2}$$

$$Q = 0.5Q_1 + 0.5Q_2. \tag{3}$$

Q is the total number of tests predicted by target, is the total number of tests predicted by patient type, and is the total number of tests predicted by device type. After obtaining the total inspection quantity according to Formula (3), the inspection quantity of each equipment type can be obtained according to the following formula:

$$Q'_{CT} = Q_{CT} * \frac{Q}{Q_2}. \tag{4}$$

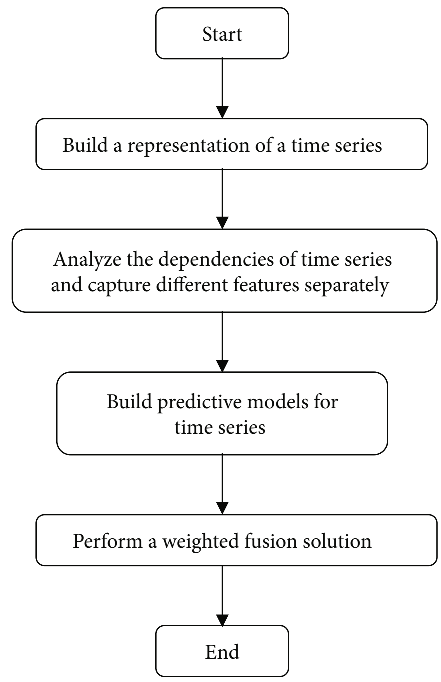

Figure 3: Sequence model flow chart.

3.3. MRI Technology and Principle. NMR signal detected by induction coil is an analog signal, which must be transformed into digital signal to reconstruct the image. Of course, the acquisition of magnetic resonance signal is not a simple digitalization of analog signal but also must conform to the sampling theorem and so on. Only by understanding the imaging method of NMR can we understand the arrangement of its original data and can we extract the data we need from the original data to calculate the distribution of T1 or T2.

There are many types of image reconstruction method; experiment using magnetic resonance imaging is a two-dimensional Fourier transform imaging. It is a special coding technique combined with inverse discrete Fourier transform and image reconstruction methods. Its characteristic is in the X, Y, and Z directions; add a gradient magnetic field to successive change corresponding direction of the spin of the proton precession phase, also known as phase encoding gradient. If the Z direction as a level will choose a gradient, with the excitation pulse function, imaging excitation level can be determined at the same time; then, in the X and Y direction applied within the excitation level on the proton gradient field space coding, acquisition of signal contains the characteristics of space information. By Fourier inverse

Table 2: Comparison table between the actual value and predicted value of inspection quantity of each equipment type in 2011.

	CT			US			MR		
	Actual value	Predicted value	Relative error	Actual value	Predicted value	Relative error	Actual value	Predicted value	Relative error
201101	4704	5020	0.0671	10946	12305	0.1239	1134	1189	0.0485
201102	4598	5112	0.1117	9732	11225	0.1534	1190	1043	0.1235
201103	5642	5518	0.0219	13757	14110	0.0256	1955	1424	0.2716
201104	5617	5678	0.0108	14338	14288	0.0034	1872	1388	0.2585
201105	5876	5772	0.0176	16591	15403	0.0716	1991	1365	0.3144
201106	5563	5782	0.0393	17100	15743	0.0793	2027	1436	0.2916
201107	5634	5748	0.0202	17409	17298	0.0063	2040	1427	0.3005
201108	5983	5864	0.0196	17314	16281	0.0596	2105	1155	0.4513
201109	5249	5897	0.1234	15988	14778	0.0756	1868	1335	0.2853
201110	5763	5991	0.0396	14772	14197	0.0389	2079	1336	0.3574
201111	5609	5841	0.0413	16180	15051	0.0697	2067	1252	0.3943
201112	5467	5972	0.0924	14400	14392	0.0005	1790	1276	0.2874
Average error	—	—	0.0504			0.0590			0.2820

transform reduction, spatial distribution of the signal can be rebuild magnetic resonance image beans.

The magnetic resonance signal is detected during the relaxation process after the rf excitation, so the strength of the magnetic resonance signal detected from a particular tissue depends not only on the relaxation time of that tissue but also on when the relaxation is measured and by what means that magnetic resonance imaging is a multiparameter imaging technique, right. The setting of various parameters involves a variety of sequences. Different sequences and parameters are required for different tissues to meet different requirements. Related technology has also developed into an independent MRI, which is also an important research area of MRI technology in medical application.

3.4. MRI T2 Measurement. Spin-spin relaxation is characterized by energy exchange between the same spin nuclei, so the relaxation efficiency is very high. After the nuclei are excited by an rf pulse in an external magnetic field, the time required for the process of reaching lateral thermal equilibrium within the spin system is called spin-white relaxation time, which is called T2.The rate of this energy transfer depends on the strength of the spin-spin interaction. T2 describes the decay of the transverse magnetization vector Mxy. In general, a 90 rf pulse shifts the equilibrium magnetization vector to the Y-axis, where Mxy = Mo. Subsequently, with the addition of 90 rf pulses, Mxy begins to decay in an exponential form. Since spin-spin relaxation is related to the inhomogeneity of the magnetic field, its result is represented by T2∗, which has a certain relationship with the true T2 of the system.

There are also various methods to measure T2. In this paper, CPMG pulse sequence is used in the actual measurement process, mainly to eliminate the influence of uneven magnetic field. If the magnetic field is not very uniform, the magnetization of the nucleus at different positions of the sample will be slightly different, resulting in the rotation of the nucleus at slightly different frequencies. When in uniform magnetic field, in any moment of relaxation process, all of the precession of the core of the same frequency rotation points to the same direction. In this case, all the precession nuclear in the same state or phase consistency and net magnetization of the spin system at any given time is equal to the system in any nuclear net magnetization precession, which can use the real T2 said. In contrast, in an inhomogeneous magnetic field, the precession core starts spinning at a different frequency. The spin points slightly differently, a phenomenon called spin precession phase dispersion. The spin core therefore loses phase consistency. Therefore, after the addition of the same pulse, the macroscopic magnetization

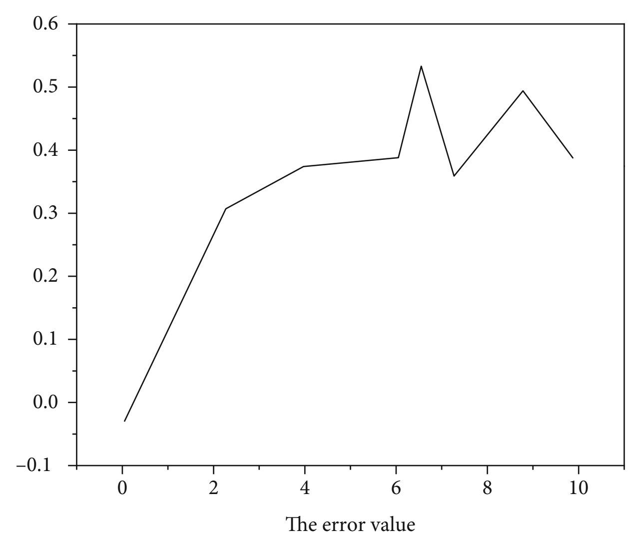

Figure 4: Statistical diagram of relative error broken line among CT, US, and MR.

vector of the spin nucleon is smaller than that of the macroscopic magnetization vector engraved simultaneously in the homogeneous magnetic field system.

4. Results and Discussion

Table 2 lists the actual predicted values and relative errors of each equipment type in 2011. It can be seen from the table that the average prediction error of CT and US is about 5%, so it can be considered that the model can predict more accurately. The error of MR is as high as 28.2%, which is due to the mutation of examination quantity. Therefore, it is appropriate to use this time series to predict the amount of CT and US examination in MRI equipment, while MR examination quantity must be predicted by other methods. Figure 4 is the broken line statistics of CT, US, and MR relative error.

5. Conclusion

This paper studies the athlete's injury prevention of MRI techniques in the sports training study, through the correlation analysis of the research on data mining technology in the MRI algorithm of medical image information system and equipment and the principle of research, and analyzed the data mining technology in the role of MRI medical imaging information system, to solve the problem of injury prevention in the sports training. The experimental results show that the average prediction error of CT and US is about 5%. It can be considered that MRI technology can predict more accurately, indicating that this model can effectively prevent injuries in training.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares that there are no conflicts of interest.

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