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Article

Research on the application of scientific training methods in the prevention of muscle injuries in young taekwondo athletes

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Abstract: The Taekwondo project originated in the Korean Peninsula. Since it was introduced to my country in the 1990s, it has attracted the attention of many people because of its high degree of appreciation. Taekwondo, characterized by its combative nature and technical demands, poses inherent sports risks, with research indicating that a significant percentage of athletes' experience sports injuries during their careers. Therefore, this study selected high-level Taekwondo athletes of S University as the survey object, and analyzed the collected data by using literature data method, questionnaire survey method, interview method and other research methods. Aiming at the injury factors of boxing practitioners' sports injuries, this research proposes the following related countermeasures: (1) The countermeasures against the practitioners themselves and the physical injury factors are: strengthen the protection or exercise of vulnerable parts; the coaches check the physical condition of the students before class; strengthen physical fitness exercises; improve self-protection awareness and ability. (2) The countermeasures against the factors that cause the practitioner's emotional and rational emotions include: exert the influence of social relations on the practitioner; eliminate fear, cultivate self-confidence; strengthen the cultivation of will quality and self-will! Relaxation and concentration training. (3) The countermeasures for coaches to prevent exercises from sports injuries include: coaches improve their own technical level and teaching skills; reasonable grouping and training methods; leading students to prepare for activities; controlling sports negatives, and technical exercises step by step. (4) Improve the problems of venue facilities that easily cause sports injuries.

Keywords: taekwondo; high-level athletes; sports injuries; muscle damage

1. Introduction

In today's society, the economy is developing rapidly, and people's living standards are gradually improving. In this context, physical and mental health-healthy sports activities have become an indispensable part of life. As a new type of sport, Beginning Boxing is becoming more and more popular among young people, and it has gradually become a fashionable fitness sport. With the promotion of the sport of seeing boxing, amateur boxing clubs across the country have been established one after another, and the public has entered a stage of rapid development with boxing.

The author found through consulting the literature that in recent years, the research on sports injuries has attracted more and more people's attention, and the books and literatures on sports injuries have gradually increased [1,2]. Most of these documents use questionnaires to discover the current situation of sports injuries in different sports groups and propose relevant solutions, but most of the target groups are high-level athletes. High-level athletes need high-intensity and heavy-load sports

training, and the probability of sports injuries is very high. Therefore, there is nothing wrong with the research on high-level athletes' sports injuries. However, with the development of mass sports in recent years, more and more researches on sports injuries of sports enthusiasts have been found in the literature, such as the current situation of sports injuries of college sports majors or the problems of sports injuries of badminton enthusiasts in a certain province or city. Wait. This shows that some scholars have realized that popular sports, as a development trend of people's fitness methods, will receive increasing attention, and the research on sports injuries of sports enthusiasts will become an important topic.

Due to the particularity of the Taekwondo project, and the Taekwondo practitioners are mainly children and adolescents with immature mental and physical development, there is a high possibility of sports injuries during the Taekwondo exercise. The impact of sports injuries on young Taekwondo practitioners is not only for the practitioners themselves, but also for clubs, coaches and students' parents. Sports injuries will not only affect the training and competition plans of the injured trainees, but also affect their own and teammates' mental state; the trainees' sports injuries may cause adjustments to the coach's curriculum and even delay the completion of the entire class training plan; at the same time, teenagers practice the athlete's sports injury is also a test for the parents of the practitioners. The original intention of the parents to let their children participate in Taekwondo training is to strengthen their physical fitness. However, there have been sports injuries that are counterproductive, which has caused some parents to give up allowing the practitioners to continue to participate in the training. In the context of sports injuries in amateur boxing and Taekwondo, some studies focus solely on student athletes in sports universities, while others examine injury locations without explaining the underlying causes. There is a lack of in-depth research linking injury prevention methods to their root causes. Given the multitude of factors contributing to these injuries, identifying the specific causes is essential for effective prevention and resolution.

In summary, the sports injuries of amateur boxing club practitioners are not only closely related to the students' physiology and psychology, but the coaches and clubs also have unshirkable responsibilities. In addition, the coaches' handling methods and attitudes after sports injuries occur. It will also have an extremely important impact on students and their parents.

This research attempts to investigate the situation of amateur boxing practitioners and coaches in Jinan to understand the current situation of sports injuries of amateur boxing practitioners, from the aspects of the practitioner's physiology and emotions, coaches, venue facilities, etc. Look for the factors that cause sports injuries and propose solutions.

This research is based on the causes and countermeasures of the sports injuries of young boxing practitioners in City A. It proposes improvement opinions and good methods for reference from the perspectives of the practitioners, coaches, venue facilities, etc., in order to reduce the number of amateur starters. The occurrence of sports injuries of boxing practitioners promotes the recovery process of the injured and the healthy development of the body. This study expands the field of research on the impact of sports injuries on amateur boxing practitioners and countermeasures. The

results obtained have a certain theoretical reference value for the research on sports injuries. It is expected to cause related clubs and clubs to cause sports injuries to boxing practitioners. Attaches great importance to prevention and rehabilitation, and implements relevant improvement measures.

This study's innovation lies in its comparative analysis between sports injury data from representative Taekwondo clubs in City A and existing professional research, offering new insights into the unique challenges faced by amateur athletes and the effectiveness of targeted preventive measures. Through practical investigation, find the basic conditions and injury factors of amateur boxing practitioners' sports injury. Practicable measures to prevent and cope with sports injuries of Taekwondo practitioners are proposed from the aspects of the students' physiology and psychology, coaches, venue facilities, etc. This study addresses the differential incidence of ankle and knee injuries, elucidating the contradictions between human anatomy and the technical requirements of taekwondo. From a physiological and medical perspective, it explains that the lateral malleolus is weaker than the medial malleolus, and the lateral malleolar tip is lower than the medial malleolar tip, leading to a higher incidence of knee injuries. During lower limb strength training, particularly in squats, many coaches fail to recognize the potential for knee injury associated with improper squatting techniques.

2. Literature review

2.1. Concept and classification

Sports injury refers to the injury of the human body during sports activities [3]. Foreign countries have the following definitions of sports injury: 1) Sports injury is a disease (athletes complain about poor treatment effects, etc.); 2) Sports injury only refers to a reduction in time for training or competition [4].

The paper conducted investigations on the following factors and divided them into the following three categories according to the degree of loss of athletic ability [3]. Mild injury: After a sports injury does not lose the ability to move, can still continue sports activities or training, such as mild abrasions, sprains, etc. Moderate injury: After a sports injury, treatment is required, and physical activities cannot be performed in a short period of time as required by physical education. It is necessary to stop or reduce activities of the affected area, such as muscle and muscle strain. Severe injury: After sports injury, you need to be hospitalized, and you can't engage in sports activities or training for a long time, such as fractures, joint dislocations, or internal organ injuries.

According to the degree of sports injury, it is divided into acute injury and chronic injury[4]. Acute injury refers to sports injury that occurs indirectly or directly as a one-time effect. Symptoms appear quickly after injury, and the course of the disease is generally short. Chronic injuries are classified into obsolete injuries and overwork injuries according to their etiology. Obsolete injuries are the result of recurring damage due to old injuries after acute injuries that have not been treated in time, while overwork injuries are caused by excessive local body load. It is caused by a long time beyond the range of its ability to bear, which is the result of local overwork. If the acute injury is not treated in time, is not treated, or enters training or competition early,

it is very likely that the acute injury will gradually turn into a chronic injury.

2.2. Psychological factors

Minick et al. [5] analyzed the physical factors of various sports injuries that occurred in training games and pointed out that the physical causes of sports injuries during exercise were mainly stimulated by unfavorable external factors and lack of adaptation. Reasons, weak will and fearful attitude, strong sense of competition and eager desire for success, athleticism, mental fatigue and poor motivation, and put forward relevant suggestions for the factors that cause injuries.

A study of 110 middle school football players by Song et al. [6]. found that injured athletes have more prominent utopian personality characteristics, and athletes who are fragile and sensitive are more likely to be injured than those who trust themselves.

Minthorn et al. [7] believes that the mental rehabilitation of personal trauma caused by sports injuries should also not be ignored. From the factors of stress response, anxiety, personality, motivation, life events, personal preparation, physical fatigue, and venue design, the rational causes of sports injuries were discussed, and necessary intervention measures for sports injuries were proposed: recognition Knowledge education, guide athletes to correct attribution: objective and honest, set feasible rehabilitation goals for sports injured persons; strengthen training to enable athletes to master and cope with skills; avoid negative assertions and analyze problem-oriented; seek social support; improve sports venues and equipment.

Sports injury-related growth (SIRG) refers to the positive psychological, social, physical and behavioral changes of athletes after injury in competition or training compared with those before injury. Analyzing and evaluating the influencing factors of SIRG can provide correct and effective guidance for coping with injuries, which is of great significance to reduce the negative impact of sports injuries[8].

Kiesel et al. [9] used the Inevitable State Scale and the Social Support Rating Scale to investigate 80 Taekwondo athletes with varying degrees of injury, and explored the relationship between the emotional response and social support of Chinese elite Taekwondo athletes after injury. The analysis results show that athletes with sports injuries of different genders, ages, and degrees of injury have significant differences in emotional responses and social support. The results indicate that different emotional responses are correlated with social support.

Oler et al. [10] analyzed the common sports injuries and characteristics of taekwondo athletes in some universities in Fujian and Hubei provinces. Using stress-injury theory analysis, they found that sports injuries are a major and depressive event for athletes. Not only does it have a disturbing impact on the learning and life of athletes, but it also produces many negative psychological effects.

2.3. Taekwondo sports injuries

Foreign studies have found that Taekwondo is one of the most popular sports in the world, with more than 80 million people participating in this sport around the world. Due to the characteristics of Taekwondo sports, sports injuries caused by practice lifting boxing have become more frequent and diverse. Due to differences in the skill level, experience and other factors of Taekwondo players, they are different

in injury location, injury type, and injury mechanism. For example, older Taekwondo athletes have a lower chance of accidental injury than younger athletes. Older athletes are more prone to sprains than younger athletes; the difference in weight between teenagers and adults is another factor that affects the occurrence of sports injuries [11].

Phillips's [12] study on 904 injured amateur boxing athletes showed that the most prone to sports injuries of starting boxing athletes were: lower limbs (54.7%), head (19.0%), and spine (14.1%). And upper limbs (12.2%); the most common types of injuries are: contusion (36.25%), sprain (18.86%), strain (14.66%), fracture (7.84%) and joint function disorder (7.27%).

Xiao's [13] survey of 80 young athletes of Taekwondo in Zhengzhou showed that sports injuries in the lower limbs were significantly higher than those in the upper limbs and waist. Knee joint injuries occurred in 40 people, accounting for 40.0%; bare joints and waist injuries. The second and third places are respectively 23.8% and 15.0%. Leg and hand injuries are the fourth and fifth places, accounting for 10.0% and 7.5%.

Through investigations, Schneiders [14] found that knee injuries were the first, accounting for 35.08%, followed by ankle injuries accounting for 28.07%, initial band injuries accounting for 17.54%, and muscle injuries accounting for 12.28%. Knee joint injuries are divided into knee medial injury, meniscus injury and skeletal injury. Many injuries have sequelae, and most injuries will recur in future training and affect athletes.

3. Research objects and methods

3.1. Research object

In 1956, Bloom first proposed "Bloom's Theory of Classification of Educational Goals" [15]. The six.

Research object: A city amateur witnesses the current situation of sports injuries of boxing practitioners. Survey object: Trainees and coaches of Kneeling Boxing Clubs in the five districts of City A, including Seoul Black Belt, Cong Jianshe, Longwu, Aidong, China-Korea, Hongde Education, Confucianism, Rongshang, etc.

3.1.1. Data preprocessing

Use Python language for data statistical analysis, use Equation (1) to perform Min-Max scaling normalization processing on all data, scale the data proportionally to the range of [0, 1], and convert the dimensional expression It is a dimensionless expression data. On the one hand, it makes 35 different mRNAs comparable to avoid losing the information generated by weak changes in genes or overly amplifying the effects of some genes, eliminating irrelevant information, and reducing the impact on subsequent analysis; on the other hand, On the one hand, the normalized data is more conducive to the establishment of mathematical models and the mining of effective information from the data.

$$x_{normalization} = \frac{x - Min}{Max - Min} \tag{1}$$

Among them, x: the relative expression of any gene data; Min: the smallest relative expression of any gene feature within 48 h after injury; Max: the highest

relative expression of any gene feature within 48 h after injury. Note that this formula is used for preprocessing the relative expression data of the same gene.

3.1.2. Correlation analysis

There may be some connections between the data, which may increase or decrease, or there may be no correlation. Correlation coefficients are usually used to describe the correlation between data, which is divided by the covariance by two. The standard deviation of each variable.

$$r(X,Y) = \frac{Cov(X,Y)}{\sqrt{Var[X]Var[Y]}}$$

Among them, $Cov(X,Y)$ is the covariance of X and Y, $Var[X]$ is the variance of X, and $Var[Y]$ is the variance of Y.

3.1.3. Cluster analysis

Hierarchical clustering is a clustering algorithm [16]. The basic principle is to combine the most similar feature variables among all data points, repeat this process many times, and analyze them by calculating the distance between each feature variable and all feature variables. The similarity between the two, the smaller the distance, the higher the similarity, and the closest feature variables or categories are combined to create a hierarchical nested clustering tree. In the cluster tree, the original data points of different categories are the lowest level of the tree, and the top level of the tree is the root node of a cluster. The Euclidean distance formula between data points is as follows:

$$d(x,y) = \sqrt{(x_1 - y_1)^2 + (x_2 - y_2)^2 + \cdots (x_n - y_n)^2} = \sqrt{\sum_{i=1}^{n}(x_i - y_i)^2}$$

Among them, $d(x,y)$ is the true distance between x and y points in the n-dimensional space; x_i and y_i: the values of all n-dimensional features of x samples and y samples.

3.2. Research methods

3.2.1. Documentary method

It mainly collects relevant information on sports injuries and preventive measures for Taekwondo athletes through CNKI, Wanfang Digital Books online materials, Internet network search queries, self-purchased books, etc. Through periodical search and other means, more than 90 pieces of literature about Taekwondo sports injuries and related materials have been consulted, and combined with the practical experience of the first boxing club, it provides a theoretical basis for this article.

(1) Random forest model

Random Forest [17] (RF) model uses information entropy or Gini coefficient to select feature variables and classify them. In essence, it is a set of classifiers composed of a series of independent decision trees. The classification result is voted by the majority of each tree. Decide so that the samples are distinguished to the greatest extent after each segmentation. The RF model is still a 'black box model', which is a

collection of classifiers composed of a series of independent decision trees. Although the schematic diagram of a decision tree cannot clearly show the reasoning process, viewing a single decision tree will show us the model (Random forest), will help us to understand the simple reasoning process of random forest model. A schematic diagram of a single decision tree is shown in **Figure 1**.

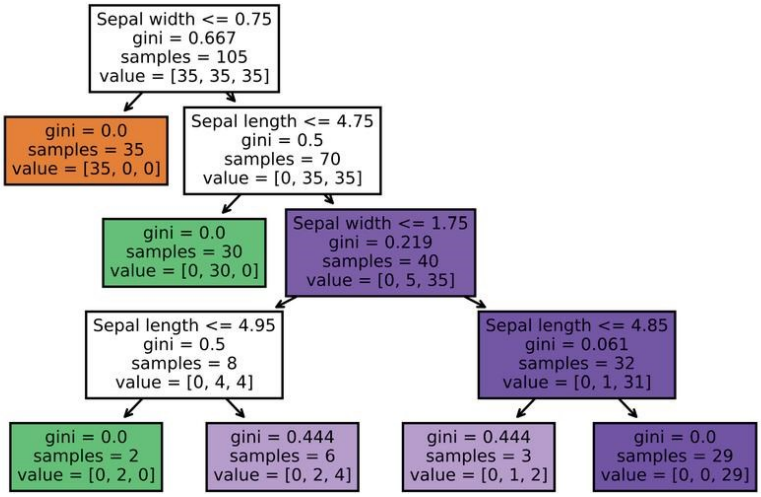

Figure 1. Schematic diagram of decision tree model.

(2) Logistic regression model

The Logistic Regression [18] (LR) model is a model that converts the regression problem into a classification problem by comparing with the threshold. The basic principle is based on the assumption function of linear regression, and each feature is multiplied by a regression coefficient , Use some optimal algorithms to find the fitting parameters that meet the best fit, and then add all the result values, and combine them through the sigmoid function to form a composite function, and then calculate a range of 0~1 The final result is obtained by comparing the magnitude of the value with the classification threshold, so the LR algorithm can also be regarded as a probability estimation algorithm.

$$z\left(x^{(i)}\right) = \theta_0 + \theta_1 {x_1}^{(i)} + \theta_2 {x_2}^{(i)} = \theta^T x^{(i)}$$

$$g(z) = \frac{1}{1 + e^{-z}}$$

$$h_\theta\left(x^{(i)}\right) = g(z) = g\left(\theta^T x^{(i)}\right) = \frac{1}{1 + e^{-\theta^T x^i}}$$

In the above formula, $i = 1,2,\ldots,m$ represents the i sample, T represents the number of features, and θ is the function coefficient; when $z\left(x^{(i)}\right) > 0$, the corresponding sample point is one type; when $z\left(x^{(i)}\right) < 0$, it is divided into another type.

(3) Polynomial Naive Bayes Model

The Multinomial Naive Bayesian [19] (Multinomial NB) model is a classification algorithm based on Bayesian theory. It calculates the conditional probability of each feature variable for classification separately, and then integrates the conditional probabilities of all feature variables and their feature vector makes classification

prediction. The Bayesian assumption is that the conditional probabilities of features in each dimension are mutually independent and random. Although this assumption cannot satisfy the complete independence of each feature in many cases, it is found from experience and theory that this conditional independence hypothesis is effective in many fields. It is also due to its characteristic conditional independence hypothesis, which greatly saves the calculation time of the model. The specific form of Bayesian theory is:

$$P(B_i|A) = \frac{P(B_i)P(A|B_i)}{\sum_{j=1}^{n} P(B_j)P(A|B_j)}$$

Among them, $P(A|B)$ is the conditional probability of A after the occurrence of B is known, and is also called the posterior probability of A because of the value obtained from B; 2 is the conditional probability of B after the occurrence of A is known, and it is also due to the conditional probability of B after the occurrence of A. The value is called the posterior probability of B. 3 is the prior probability of A. It is called "a priori" because it does not consider any B factors.

(4) Comparison of models

On the basis of LDA's dimensionality reduction analysis of damage time, Python language is used to establish RF model, Multinomial NB model and LR model, and further research and analysis of damage time are carried out. All characteristic genes of the above three mathematical models are entered into the model, and the model parameters are optimized by the grid search method, and the performance of the model is tested using internal verification (leave one out method) and external test sets. In this study, the external test set brought the data obtained from another batch of 13 rats into the established model to test the generalization ability of the model to unknown samples and avoid the occurrence of over-fitting in the process of model building.

Model evaluation index: Receiver Operating Characteristic (ROC) is a visual tool for evaluating the performance of classification models. It defines the false positive rate (FPR) and true positive rate (TPR) as the x and y axes, indicating the true positive rate and the relationship between the false positive rate, the closer the ROC curve is to the upper left corner, the higher the accuracy of the model. The point closest to the upper left corner of the ROC curve is the best threshold with the least errors, and the sum of the false positive rate and false negative rate the smallest. With the ROC curve, the definition of Areas under the Curves (AUCs) can be drawn: the area under the ROC curve, the larger the value, the better the performance of the model, the more accurate the identification of the sample, and each prediction result It is represented by a point in the ROC curve. as shown in **Figure 2**.

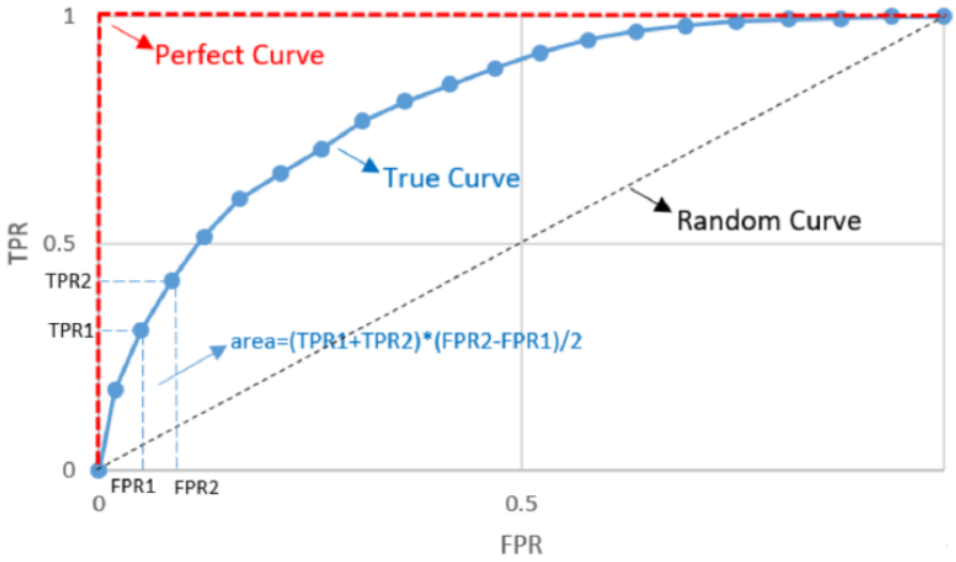

Figure 2. Schematic diagram of ROC and AUCs.

3.2.2. Questionnaire survey

(1) Questionnaire design

According to the research needs of this subject, experts in sports science and Taekwondo club coaches were consulted. In accordance with the principles of questionnaire design, a questionnaire for amateur Taekwondo practitioners with sports injuries in City A and a questionnaire for coaches were designed. The purpose of the questionnaire survey is: 1. To understand the current situation of sports injuries of amateur Taekwondo practitioners in City A. 2. Understand the current situation and basic composition of amateur taekwondo coaches in City A. 3. Understand the injury factors of amateur taekwondo sports injuries in City A. 4. Propose countermeasures against injury-causing factors.

(2) Validity and reliability of the questionnaire

Validity: In order to ensure the validity and reliability of the questionnaire, I submitted the two questionnaires to 3 professors, 4 associate professors, and 2 lecturers in the School of Physical Education of Shandong University, and asked them to evaluate the validity of the questionnaire, including content design and structure design. In two aspects, the evaluation indicators are reasonable, relatively reasonable, and unreasonable. The results are as follows (see **Table 1**):

Table 1. Questionnaire validity test.

Job title	Number of people	Reasonable	More reasonable	unreasonable
Professor	3	1	2	0
Associate Professor	4	3	1	0
Lecturer	2	2	0	0
Total	9	6	3	0

The reasonable, relatively reasonable, and unreasonable three-level assignments of 2, 1, and 0 are carried out in turn, and the calculated average is 1.67, which is closer to reasonable. Therefore, the validity of the questionnaire can reflect the problem to

be studied.

Reliability: Test the reliability of the questionnaire with the retest method. One week after the first round of questionnaires were issued, 35 trainees and 5 coaches from a gym (Seoul Black Belt) were selected to re-issue the questionnaire. Retest result: the average value of the student's correlation coefficient $r = 0.84$. Look up the table and find that $\rho < 0.01$; the average value of the correlation coefficient of the coach is $r = 0.91$, and look up the table that $\rho < 0.05$. The reliability of the questionnaire meets the requirements of this research.

(3) Selection of survey subjects

After interviews and investigations, it is learned that there are five major chain amateur boxing clubs in City A, namely the Chemical Construction Taekwondo Club, with 9 chain stores in the city; the Seoul Black Belt Begin Boxing Club with 10 chain stores in the city; and Longwu amateur boxing club. Clubs, there are 7 chain stores in the city; Aidonglu Boxing club, there are 7 chain stores in the city; China-Korea Wisdom Boxing Club, there are 5 chain stores in the city. One of the five chain clubs in the five districts of City A will be randomly selected, plus eight Taoist gymnasiums including Hongde Education, Confucianism, and Rongshang selected randomly. Randomly select H classes for the gymnasium (the class size is about 15 students): elementary class (training period of about 1 year), intermediate class (training period of about 2 years), advanced class (training period of more than 3 years). Due to the investigation of sports injuries of Taekwondo practitioners in the past year, no trainees with less than one year of training were selected. The students are 7–15 years old, with an average age of 10.7 years; among them, the average age of junior class students is 8.3 years, the average age of intermediate class students is 10.5 years, and the average age of senior class students is 13.4 years. The coaches are 19–35 years old, with an average age of 24.4 years old. yi took the coaches of these 8 gyms and other individual gyms as the survey subjects. Conduct interviews and questionnaire surveys. (see **Figures 3–5**)

Figure 3. Flexion training.

Figure 4. Stretching training.

Figure 5. Recovery training of ankle range of motion.

(4) Issuance and collection of questionnaires

The responsible coach of each class is requested to be the investigator. In the early stage, the investigator should be trained on the precautions for filling in the questionnaire. The questionnaires will be filled out and collected after the training. For younger students, parents will help fill it out. For practitioners who have suffered multiple sports injuries, fill out a questionnaire for each injury. A total of 394 questionnaires were distributed to trainees and coaches selected to participate in taekwondo practice, such as the Seoul Black Belt, Cong Jianzhu, Longwu, Aidong, China and South Korea, Hongde Education, Confucianism, Rongshang, etc., and 371 copies were recovered, The recovery rate was 94.2%, of which 353 were valid questionnaires, with an effective rate of 95.1%. According to Kebi's point of view, a recovery rate of more than 70% is very good. % Of the answers were given by coaches and club managers, and 317 were given by trainees. Investigation location: Taekwondo clubs such as Seoul Black Belt, Cong Jianshe, Longwu, Aidong, China and South Korea, Hongde Education, Confucianism, Rongshang, etc. in City A. Investigation

period: May 2014–October 2014.

3.2.3. Mathematical Statistics

Use the Excel table to sort out the relevant statistical data, and through comparative analysis, find out where the taekwondo practitioners are injured, the main types of injuries, the severity of the injuries, and the main factors causing injuries.

4. The current situation of sports injuries of amateur boxing practitioners in A

4.1. Incidence rate of sports injuries of amateur boxing practitioners in city A

The statistical results show that among the 317 Taekwondo practitioners surveyed, 109 had different degrees of sports injuries in the last year, accounting for 34.4% of the research subjects, and the total number of injuries was 143. This indicates that the Taekwondo practitioners were injured. The situation is more serious. Comparing the injuries of trainees of different genders and training years, research shows that the incidence of injuries of trainees of different training years has significant differences (see **Tables 2** and **3**).

Table 2. The incidence of sports injuries among Taekwondo practitioners of different genders.

Gender	Number of surveys	Injured	Injury incidence（%）
Man	174	91	52.3
Woman	143	52	36.4
Total	317	143	45.1

It can be seen from **Table 2** that the total incidence of sports injuries was 45.1%, the incidence of male injuries was 52.3%, which was slightly higher than that of women's 36.4%. Compared with female students, the strength, range and difficulty of the movements of male students in training may be greater than that of female students, so they are more prone to injury.

It can be seen from **Table 3** and **Figure 6** that the proportion of injury cases varies between different training years. The injury incidence rate for about one year of training is 38.0%, which is higher than 31% for 2–3 years of training. 1%; the highest incidence of sports injuries among trainees who have trained for more than 3 years is 69.9%, and 24 of the trainees who have been trained for more than 3 years have suffered two or more injuries in the most recent year. Trainees with a training period of 1 year are beginners. Although they are not very demanding in training, they are not very proficient in the application of technical movements due to beginners, have poor control over the body, and are prone to make some mistakes. Therefore, the total number of injuries and the incidence of injury is also higher. The injury rate of trainees with a training period of 2–3 years is relatively low. This is because after a stage of training, the trainees have initially possessed the physical fitness required for training. As time goes by, students become more familiar with the content of classroom teaching, so they can better control their bodies to complete actions and avoid injury. The injury is relatively concentrated on the trainees who have been training for more

than 3 years. There are two main reasons: first, these trainees are responsible for part of the competition tasks, and they will participate in more intense training before the game; second, the coaches are concerned about this trainee of the period have higher requirements in training, and some trainees are sent to practice combat training that is most prone to injury.

Table 3. Sports injury rate of Taekwondo practitioners with different training years.

Training years	Number of surveys	Injured	Injury incidence（%）
About 1 year	121	46	38.00
2–3 years	103	32	31.10
over 3 years	93	65	69.90

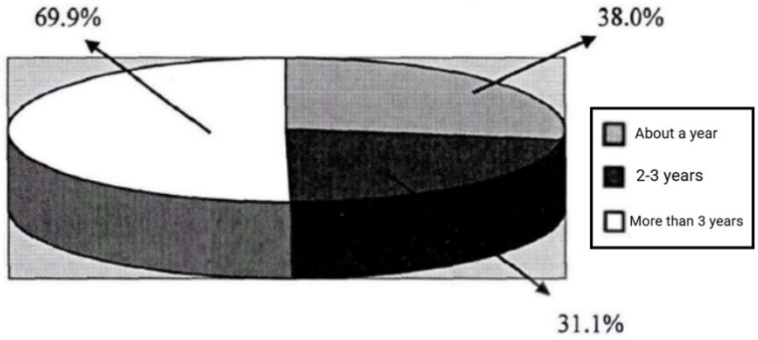

Figure 6. The incidence of sports injuries among Taekwondo practitioners in different training years.

4.2. Sports injuries of amateur boxing practitioners in City A

According to statistics of 109 trainees who suffered injuries, among the 143 injuries, the toe injury rate was the highest, with 34 injuries, accounting for 23.8% of the total injuries; 23 injuries by stepping on the joints, accounting for 16 of the total injuries 1%, 22 people with secondary finger injuries accounted for 15.5%, and 21 people with knee injuries at the secondary level accounted for 14.7%, ranking fourth. The number of leg injuries was 19, accounting for 13.3%, ranking fifth. The number of injuries to the head, waist, arms, and wrists was relatively low, 7, 7, 5, and 5 respectively. Different from the previous surveys and studies of professional Taekwondo athletes, the high incidence of injury is the knee joint or the knee joint. The statistical results of this survey show that the most vulnerable part of amateur Taekwondo practitioners is the toe; secondly, the probability of finger injury is also higher. As shown in **Table 4**.

Table 4. Frequency statistics of athletes' injured parts.

Occurrence site	Person times	Percentage (%)
head	7	4.9
arm	5	3.5
wrist	2	3.5
finger	22	15.4
waist	7	4.9

Table 4. (*Continued*).

Occurrence site	Person times	Percentage (%)
Legs	19	13.3
Knee joint	21	14.7
ankle joint	23	16.1
toe	34	23.8

5. Analysis on the causes of sports injury of taekwondo practitioners in city A

Sports injuries of Taekwondo athletes occur from time to time. According to relevant investigations and studies, some teams' injuries to young athletes have reached 100%. According to literature and survey results, amateur Taekwondo trainees are mostly children and professional athletes are mainly teenagers and adults. The reasons for sports injuries between amateur Taekwondo practitioners and professional Taekwondo athletes are due to the differences in physical characteristics, practice motivation and training methods. A big difference. The survey results of 143 amateur Taekwondo practitioners with sports injuries show (see **Table 5**) that there are many reasons for the injuries of amateur Taekwondo practitioners in City A. The specific analysis is as follows:

Table 5. Main causes of sports injuries.

Cause of injury	Person times	Percentage (%)
Unreasonable warm-up	14	9.8
Partially overburdened	57	39.9
Sports fatigue	26	18.2
Physical fitness reasons	45	31.5
Lack of technology	77	53.8
Inattention	51	35.7
Insufficient self-protection	37	25.9
Psychological and emotional factors	32	22.4
Site facilities issues	23	16.1

5.1. The trainee's own and physical injury factors

5.1.1. The contradiction between the weakness of human anatomical structure and the technical requirements of Taekwondo

The gift point is for the technical bell points of the Taekwondo project itself, which is encountered by both professional athletes and amateur Taekwondo practitioners. The survey results of sports injuries of amateur Taekwondo practitioners in City A show that the incidence of ankle and knee injuries is very different. This result has a lot to do with the contradiction between the human anatomy and the technical requirements of Taekwondo. From a physiological and anatomical point of view, the main factors causing this result are that the lateral frontal band of the ankle joint is weaker than the medial initial band, and the tip of the lateral malleolus is lower

than the inner abrupt tip. There are many injuries to the knee joints. In the squat in which the trainer guides the students to practice lower limb strength exercises, most coaches do not pay attention to the damage to the knee joint by the squatting action. In the fully squat state and the squat to stand up quickly All the situations put a lot of pressure on the knee joints, which can cause chronic injuries over time.

Through watching the training, it is found that in the promotion examinations of the Taekwondo clubs in City A, the status is a very important examination content. All gymnasiums in City A regard Pingshi teaching as an important teaching content. In order to consolidate the content of the exam before the test, many students practice Pingshi for the entire class. The leg technique in Ping Shi requires leg control, and the front kick is the most important technical action in Ping Shi. In order to achieve the effect of beauty and performance, students are required to bounce the calf as much as possible at the moment of kicking out. Controlling the legs instantly, this process is prone to damage to the meniscus due to prolonged hyperextension of the knee joint.

5.1.2. Lack of physical fitness

The analysis of the causes of sports injuries among amateur Taekwondo practitioners in City A showed that 45 of the 143 people with sports injuries chose the cause of sports injuries to be related to insufficient physical fitness, accounting for 31.5%, ranking third.

In daily training, athletes must first have the physical fitness to complete the movement before learning a certain basic boxing method or leg method. The difference in physical fitness between amateur Taekwondo athletes and professional Taekwondo athletes is that professional Taekwondo athletes have undergone layers of selection and competition, so they basically have the general physical fitness and special physical fitness to practice Yi Kwon Do, while amateur Taekwondo athletes The physical fitness of athletes is uneven, and the difference is very large. The investigation found that when the beginner students of the Taekwondo Club in City A entered the trial class, in order to be able to quickly integrate into the team, the coach blindly asked the students to perform the same intensity as other students without knowing their physical fitness. Training and games, therefore, due to lack of physical fitness, students often experience physical overdrafts and fall and age feet.

Teenagers are in a critical period of physical growth and development. Coupled with the spoiling of their parents, the physical fitness of most teenagers is not optimistic. Improving their physical fitness is also an important reason why most parents let their children practice Lu Quan. In training, the contradiction between the coach’s teaching requirements and the student’s physical fitness is hugely different, which is an important contradiction that causes the student’s injury during training.

6. Conclusion

1) Sports injuries of Taekwondo athletes in city A are more common. The injury rate is more than one-third, and the injury rate of boys is slightly higher than that of girls. There are certain differences in sports injuries among practitioners of different training years. Training for 3 years the incidence of injury is the highest, with more than two-thirds having sports injuries.
2) The most vulnerable part of taekwondo practitioners at A is the toe, and the

incidence of toe injury is close to a quarter of the total number of injuries; the other vulnerable parts are stepping on the joints, fingers, knees, and legs in order; In terms of the nature of the injury, acute injury exceeds 80%; the degree of injury is mostly mild or moderate injury.

3) In terms of the types of sports injuries, more than one-third of the practitioners suffered sprains, and nearly one-quarter of the practitioners suffered contusions. Skin injuries and muscle injuries ranked third and fourth.
4) The period of injury is mainly concentrated in leg exercises and actual combat exercises, accounting for 28.7% and 23.8% respectively. Different from professional Taekwondo athletes, more sports injuries also occur during game sessions and free activities.
5) The primary causes of sports injuries among Taekwondo practitioners can be categorized as follows: (1) Physiological factors inherent to the athletes, such as anatomical weaknesses that predispose them to injuries. (2) Insufficient physical fitness, which fails to meet the demands of rigorous Taekwondo training. (3) Technical inadequacies, where improper execution of moves increases the risk of injury.
6) A large number of studies have proved that in the process of Taekwondo, how to improve training and reduce injuries needs to be implemented from the following points: (1) Strengthen general sports and increase physical fitness in order to engage in Taekwondo. (2) The psychological factors of exercisers are more important in sports, and they should have strong psychology for psychological training. There are important advantages to playing this sport. (3) Practitioners can engage in experienced trainers, control the exercise load, and monitor the body's exercise ability in real time. (4) Carry out safety inspection of sports venues to meet the requirements of sports.

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