

A Novel System to Analysis the Risk Factors of Skydiving

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Abstract

Because of its breathtaking and challenging, skydiving is known as “the sport of the brave” and has a certain degree of danger. Through reading pieces of literature, combined with the previous research results, sorting out the parachuting safety accidents involved in literature, the injured people, injury sites, injury types, and clinical manifestations of parachuting were counted, and the corresponding injury causes and treatment plans were analyzed. In order to better assess the dangers of skydiving, a skydiving risk assessment system is presented in this paper, combining previous research refined evaluation index system, index weights determined by analytic hierarchy process (AHP), and through the expert scoring method, a quantitative analysis of each index, the risk control level table, ultimately determine the species of the dangers of skydiving. The results showed that. This paper gives an example to verify the rationality and effectiveness of the

evaluation system for parachuting sports. The evaluation system can provide a reference for parachuting sports training institutions to carry out targeted protection and training, and relevant protective equipment manufacturers can also refer to this system for targeted design and production.

Keywords

Skydiving; Risk Factors; AHP; Evaluation system

Introduction

The research background of this paper is about the branch of skydiving in extreme sports. At present, there are many bases and coaches for this sport in China, but there are no risk factors and analysis of skydiving for the public in the market. Therefore, the paper wants to analyze and sort out the risk factors related to parachuting through this research to provide a safety guarantee for this sport. The main purpose of this

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article is to analyze the risk factors of skydiving and try to make recommendations to avoid similar injuries and losses in various skydiving-related fields. The research method mainly uses the analytic hierarchy process (AHP), and the expert scoring method is used to analyze and quantify the value and proportion of the elder brother index, and the value of different items is compared by matrix and risk grade table. The research summarizes the types, causes, clinical treatment, and methods to avoid various injuries caused by parachuting by searching for previous articles and conclusions. In the process of searching for existing studies, the paper thought and drew my conclusions and opinions, and conducted statistics and tests on them. After that, the paper made a quantitative analysis of my conclusions and research with specific methods, sorted them into different tables, and used corresponding formulas to test whether the data was correct and reasonable. With the gradual popularization of skydiving, training bases for skydiving have been developed in many places.

Therefore, it is more meaningful to analyze the risk factors of skydiving. This kind of research can provide some effective and real references for ordinary people and professional coaches. And this kind of research can improve public awareness of all aspects of the sport, especially the dangers that skydiving can bring and how to avoid them. At the same time, this kind of research also has significant significance for large-scale parachute training in the army. It can bring safety and technical guarantee for parachute training to the army, and provide theoretical and case references and support to reduce efficiency reduction and economic loss caused by sports injuries. In the beginning, the paper planned the general content of the whole article. The second part summarizes and analyzes the previous research results and summarizes the content into 5 parts, each part

has a different emphasis and direction. The third part is the quantitative analysis and inspection of the data and conclusions obtained by me. It first introduces the methods used and then applies them to practical applications. The last part is a summary of the whole article, which summarizes the content involved in the article and puts forward some suggestions on related fields.

Literature Review

Skydiving is a dangerous sport, and many scholars at home and abroad for the related risk factors studied, through reading literature, this paper combined with jump a lot has happened safety accidents, the injured people, injury parts and injury types, clinical manifestation, etc. And analyzes the corresponding damage causes and treatments, which helps to avoid the damage suggestion given.

Injury Population and Type

According to Xiong Xie (1998) and Maowei Wang (2001), military recruits suffered the most parachuting injuries, Injuries, and injuries that occurred during landing. However, after the annual parachute training, the injury of the recruits is significantly reduced, so the incidence of parachute injury is closely related to the parachuting skills of the parachute. However, people with different proficiency are troubled by different injuries. In parachuting training, recruits mainly suffer from lower extremity joint dislocation and ankle joint fracture and dislocation injuries are the most. However, frequent parachuters with continuous improvement in parachuting skills suffer fewer lower extremity injuries and mainly suffer from upper extremity joint dislocation. New umbrella part at the beginning of the training for ground simulation training platform more skydiving because the site is not soft, landing position is not correct, waist and leg ministry withstand shock ability are poor, easy cause soft tissue injuries of

lumbocrural pain, old umbrella member often jump, spine by opening an umbrella and landing impact of repeated impact and as the growth of the age, the ligament is flabby, thin bone lose, the easy occurrence of lumbar muscle strain, bone changes appear lumbar leg pain. Because new parachuters are not proficient in parachuting technology at the initial stage of parachute training, they have poor judgment and adaptability to the terrain and objects in the landing area and are not fully prepared for unexpected dangers, which affects the normal play of parachute technology, so the incidence of parachute injury is the highest. Compared with regular parachuters, this kind of person has to complete a variety of parachute training and parachuting exercises every year. As the number of parachuting increases, the difficulty of parachuting increases, and the accident danger also increases. Frequent skydivers are the most technical backbone. With the change of identity and the growth of age, their participation in physical training has been reduced year by year, and their physical quality has gradually declined. They are prone to disease.

Injury Site

Xiong Xie (1998), studied the cases of professional skydivers in terms of the injury sites caused by skydiving and found that the ankle joint was the most dislocated, followed by the elbow and the shoulder joint. Ankle dislocation with fracture was the highest, accounting for 70 percent of the total cases.2%, accounting for 89% of all combined fracture injuries.2%, accounting for 98 % of ankle dislocations.1%; Single ankle injuries accounted for 28 percent.1 percent, double ankle injuries accounted for 48.4 percent, and triangle fractures accounted for 15 %. Fractures of the distal tibia affected the articular surface by 7 %.8%. However, in the general population, the major parachuting injuries are limb fracture and dislocation, spinal fracture, and

nerve damage. Landing injuries were the most common, and lower limbs and spine were the main injuries. Elbow dislocation was the most common, followed by shoulder and hip dislocation. Spinal compression fractures are also more common, the impact force of which spinal column compression due to landing impact account for 75.0%umbrella cannot be ignored, Because the impact force caused by opening the umbrella fracture for 25.0%. Frequent skydiving can also occur causing long-term aftereffects for skydivers, with 90 percent of frequent skydivers suffering from lower back pain 25 years later. The incidence of spinal bone changes accounted for 30.5%.

Causes of Damage

According to Xiong Xie (1998) Maowei Zhang (2001) and Yongxue Zhang(2007), landing trauma injury when more than an open umbrella, and give priority to with leg ankle injury, open the umbrella is given priority to with arm elbow dislocation, this mainly is the machine speed is too large, open umbrella overload value increases, parachuter hard to maintain the correct posture, the body or askew, It is related to the lash of the harness system and the sudden pull of the parachute rope along with the garment. At the same time, falling from high places can increase the impact force of landing, and strong violence can cause spinal compression fractures and lower limb fractures, and dislocations. At the same time, there are various reasons for landing injuries. Changes in natural environmental factors such as different terrain, climate, and wind speed can often lead to changes in parachuting landing posture, improper landing site selection, upwind landing, upwind landing, and landing impact on obstacles, increasing landing difficulty. Spinal compression fractures due to impact of landing accounted for the majority of Landing injuries (75.0%). The research points out that the new skydiver is completely in the passive landing

state. The diver's actual parachute jumping, especially at the moment of grounding, the pull force of the umbrella to the human body is reduced, the landing speed is high, the impact force of the ground to the human body is enhanced, and the leg injury is easy to occur. The number of times the students jump onto the platform is not enough to adapt to the impact of the actual parachuting landing on the ground facing the human body, because the leg strength, joints, ligaments, and muscles are poor load-bearing capacity.

At the same time, failure to master landing techniques, incorrect landing movements, inadequate mental preparation, and poor special strength quality are also the main reasons for leg injuries, such as manic joints, knee joints, shin legs, and other parts. Causes of landing injuries and mental tension, complex terrain, ground wind speed is too large terrain complex. And new parachuter has more damage reason, this kind of person for the first time skydiving or parachute exercise replacement model, umbrella and different geographical climate is prone to fear when parachuting, affect the normal play of the parachute technology, away from the machine hurt by bad posture can collide machine door, open the umbrella body before askew, tumbling, loose can increase open an umbrella impact caused by trauma, Body loose open umbrella easily cause rope, umbrella strap hanging limbs injury. At the same time, multi-type, multi-umbrella type, multi-level intensive parachuting is a very test of the parachuter's skills, if the umbrella operation technology is not skilled, often can cause two umbrella collision, cross and overlap failure phenomenon, umbrella alternant failure caused by falling injury. Therefore, the main causes of parachuting injury are the mastery of the parachuting technique and the change in the natural environment. Another part of the reason is that the departure posture is not

good, the air body rolls, Skew, and lose the action direction of the immediate impact force is not consistent with the longitudinal axis of the body, sudden deceleration, the impact force of the opening of the umbrella directly acts on the spine causing vertebral compression fractures. With the increase of parachute speed, the impact force of parachute opening also increases, and the incidence of the spinal cord and brachial plexus nerve injury also increases. In the study, the probability of parachute failure was small, but the height fall injury was the most serious parachute injury.

Clinical Manifestations and Treatment

There are some researches carried out a physical study on some cases. There was a tearing sensation in the knee at the time of the injury, swelling and pain joint after the injury, tenderness in the joint space, limited movement of the knee joint, and the affected limb could not touch the ground when claudication was serious. When patients flex and extend the knee or squat, they can hear the bouncing sound or feel the joint bouncing, and a small number of patients also have a "joint locking" phenomenon. (Maoxue Zhang 2007). Studies have also shown that the treatment option for skydivers is bed rest after an injury. With gypsum support to limit the knee activities, local detumescence and analgesic Chinese medicine external application, with physical therapy, while taking small huoluodan, sanqi tablets, shuJinhuoxue tablets, and other drugs. The symptoms of joint hematoma are obvious, you can extract all blood after compression bandaging fixed, according to the local recovery of the quadriceps muscle timely exercise. If there is no effect after more than 2 months of non-surgical treatment, surgical treatment should be transferred to a superior hospital (Maoxue Zhang 2007).

Avoid Damage

According to Xiong Xie (1998), Maowei Zhang (2001), and Yongxue Zhang (2007). The research points out that the main measures to prevent and control parachute injury are to strengthen ground training, improve the landing environment, choose suitable climate, reduce aircraft speed, update parachute gear and strengthen the simulation training of accident danger. It has been pointed out in some cases that when parachuting at the same speed, the incidence of parachuting injury is significantly different between different parachute types. It shows that a parachute with good cushioning performance can reduce the impact force of opening and reduce the occurrence of opening injury. At the same time, it is also an effective means to improve the understanding of people at all levels of parachute injury prevention and strengthen the guidance and supervision of functional departments. Ideology is also a very important factor, increase ideological education, repeatedly emphasize the purpose, significance, and role of parachute training, and establish the idea of safety first. Eliminating individual students' paralysis, relaxation of mind, and safety awareness is not strong, competitive psychology. The teaching method is also very important, improving the teaching method, and strengthening basic technology training repeatedly. The teaching and training plan should be made and carried out in accordance with the training principles and should be taught strictly according to the three stages of landing movement formation. Correct wrong movements in time, emphasize "three tight and one flat", so that students can master the essentials of landing movements skillfully, do not pass the landing movements do not parachute, so as to avoid injury accidents due to technical movement mistakes or technical movements are not skilled. Besides, teaching and training should be arranged reasonably to prevent excessive fatigue and strengthen medical supervision and self-

supervision in training courses. When it is found that the body part, especially the leg pain and discomfort or minor injury, an old injury, and other abnormal phenomena, it is necessary to adjust the training intensity and amount in time. Avoid a large amount of exercise training and injury training under the state of fatigue. At the same time, researchers should pay attention to ground training and preparation activities before parachuting. In accordance with the principles of scientific training such as step by step, the general preparatory activities and specialized preparatory activities are effectively combined. Strictly implement the training ground, parachute landing area, and equipment health supervision. Ground training places and equipment should be kept in good condition, and regular safety inspection, maintenance, and training clothing should be strict requirements. Researchers should also strengthen parachuting action ground training, especially landing action training, gradually enhancing the muscle strength of the leg, and improving emergency ability. Researchers should also pay attention to mental health education and training, skydiving training is easy to cause mental tension, usually should carry out psychological quality education and adaptability training, gradually overcome the nervous psychology, to the overly nervous personnel to strictly check the pass. Do a good job of rescue work at the landing site. Pay attention to the movements of the parachuters. If the parachuters fall during landing or act abnormally after landing, they should rush to the site for timely treatment. Finally, appropriate weather and a reasonable site should be selected. The ground wind speed should not exceed 5m/s when parachuting, buildings, rivers, and trees should be avoided as far as possible when landing on plain terrain, and obstacles should be avoided when landing on hilly terrain.

Discussion of Skydiving Hazard Assessment

System

The third chapter firstly introduces the connotation of the analytic hierarchy process (AHP) and concepts, using the analytic hierarchy process (AHP) to determine the weight of each index in skydiving, a quantitative analysis of each index through an expert scoring method, to control risk rating table to determine the risk level, at this point, risk evaluation system has been completed, and in a numerical example is given to set up the system to test for us.

Analytic Hierarchy Process

The analytic hierarchy Process (AHP) is a decision-making method that disintegrates the elements always related to decision-making into the levels of objectives, criteria, and schemes, and makes qualitative and quantitative analyses on this basis. <https://baike.baidu.com/item/%E5%86%B3%E7%AD%96/1513><https://baike.baidu.com/item/%E5%85%83%E7%B4%A0/9563210><https://baike.baidu.com/item/%E5%AE%9A%E6%80%A7/2704301><https://baike.baidu.com/item/%E5%AE%9A%E9%87%8F/8916396>The method combines quantitative analysis with qualitative analysis, using the experience of decision makers to judge the standard of each target realization between the relative important degree, and give each decision reasonably plan for each of the standard weight, use of weighting the pros and cons of each solution sequence, is effectively applied to the subject that's hard to use quantitative methods to solve. The steps of the analytic hierarchy process are described in detail as follows:

Construction of Index System

According to the nature of the problem and the overall goal to be achieved, the analytic hierarchy process (AHP) decomposes the problem into different component factors and gathers and combines the factors at different

levels according to the interrelated influence and membership of the factors to form a multi-level analysis structure model. Finally, the problem comes down to the determination of the relative importance weights of the lowest level (for decision-making schemes, measures, etc.) relative to the highest level (overall goals) or the order of relative merits and demerits.<https://baike.baidu.com/item/%E9%A%B6%E5%B1%9E%E5%85%B3%E7%B3%BB/8924394> According to the nature of the problem and the overall goal to be achieved, the analytic hierarchy process (AHP) decomposes the problem into different component factors and gathers and combines the factors at different levels according to the interrelated influence and membership of the factors to form a multi-level analysis structure model. Finally, the problem comes down to the determination of the relative importance weights of the lowest level (for decision-making schemes, measures, etc.) relative to the highest level (overall goals) or the order of relative merits and demerits.

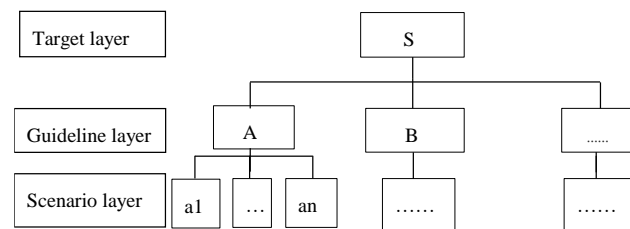


Figure 1. The example of index system

Establishment of Judgment Matrix and Consistency Test

According to the relative importance of each index, the judgment matrix is constructed and the consistency of the judgment matrix is tested.

The assignment criteria of relative importance are as follows:

Table 1. The standard table of relative importance assignment

Meaning		Scale C_{ij}
Ci	Absolutely important/advantageous	9
	Be of great importance/advantage	7
	Be more important/advantageous	5
	Slightly important/advantageous	3
Ci and Cj	Equally important/advantageous	1
Cj	Slightly important/advantageous	1/3
	Be more important/advantageous	1/5
	Be of great importance/advantage	1/7
	Absolutely important/advantageous	1/9
The above two adjacent judge the median value		8, 6, 4, 2, 1/2, 1/4, 1/6, 1/8
Not sure		N/A

Where C_{ij} – the importance of index i relative to j .

Construct judgment matrix:

$$\begin{bmatrix} C_{11} & C_{12} & \dots & C_{1n} \\ C_{21} & C_{22} & \dots & C_{2n} \\ \dots & \dots & \dots & \dots \\ C_{n1} & C_{n2} & \dots & C_{nn} \end{bmatrix} \quad (1)$$

In order to avoid data contradiction and conflict, a consistency test is an essential step in the construction of a judgment matrix. And you can use this method to judge whether the matrix is qualified.

$$CI = (\lambda_{\max} - n)/(n-1) \quad (2)$$

Where λ_{\max} is the maximum eigenvalue, CI is the consistency indicator, and n is the dimension of the matrix.

$$CR = CI/RI \quad (3)$$

Where RI is the average random consistency indicator.

When the maximum judgment value of a matrix is n , the matrix is a uniform matrix

When $CR < 0.1$, the consistency of the judgment

matrix can be considered acceptable. Otherwise, the judgment matrix needs to be modified. The way to correct it is to adjust it on the consistent matrix.

Determine the Weight of Indicators

There are many methods to determine the weight of indicators, and the three most common methods are introduced here.

(1) Arithmetic Average Method for Weight

Step 1: Normalize the judgment matrix by column (divide each element by the sum of its columns).

Step 2: Add the normalized columns (row by row).

Step 3: Divide each element of the resulting vector by n to get the weight vector.

$$w_i = \frac{1}{n} \sum_{j=1}^n \frac{a_{ij}}{\sum_{k=1}^n a_{ki}} \quad (4)$$

(2) Geometric Average Method for Weight

Step 1: Multiply the A elements by row to get a new column vector.

Step 2: Raise each component of the new column vector to the n power.

Step 3: Normalize the column vector to get the weight vector.

$$w_i = \frac{(\prod_{j=1}^n a_{ij})^{\frac{1}{n}}}{\sum_{k=1}^n (\prod_{j=1}^n a_{kj})^{\frac{1}{n}}} \quad (5)$$

(3) Eigenvalue Method for Weight (commonly used)

The first step: find the sum of the maximum eigenvalues of matrix A and its corresponding eigenvectors.

The second step: normalize the feature vector to get the weight.

$$k \left[\frac{1}{a_{11}}, \frac{1}{a_{12}}, \dots, \frac{1}{a_{1n}} \right]^T, (k \neq 0)$$

The weight of each project can be obtained through the above formula, which is convenient for scoring and establishing the evaluation system of a risk degree.

Analysis of Risk Factors of Skydiving

This section will be combined with the above content, the construction of a skydiving risk evaluation system, to provide a reference for related industries. The steps and connotation of the analytic hierarchy process are introduced in detail above. Next, we will use this method to determine the weight of the danger index of skydiving. First of all, combined with the investigation of the second part, the index system of parachuting risk factors is established, and then the judgment matrix is constructed according to the relative risk of each index, and finally, the weight of each index is determined. Through the expert scoring method, determine the index score value, combined with the danger grade table, and finally, determine the danger grade of skydiving.

Establishment of the Index System

According to the second part of the summary of the previous work, injury, and injury of different factors is the focus of investigation and damage, and there are many types of injury, that will be affected by many external factors, resulting in a

different part of the damage, the limbs, ankle and shoulder joint and some other important joints is the most frequent damage. The injury is caused by many factors, which can be divided into two categories, namely internal and external factors. These two categories have the same impact and are both crucial. Combined with the introduction of 3.1.1, the following indicator system is established:

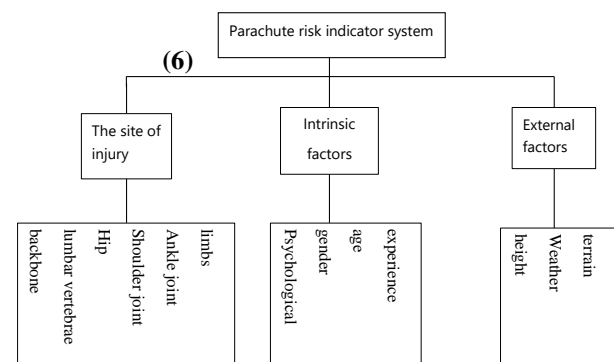


Figure 2. Index system of skydiving

In the figure above, the first-level indicators are: injury site, external factors, and internal factors; The secondary indexes of injury sites were limbs, ankle, shoulder, hip, lumbar spine, and spine. The secondary indexes of internal factors include experience, age, sex, and psychological quality. The secondary indicators of external factors are terrain, weather, and height.

Construction of Judgment Matrix

Relative Risk Degree

According to the relative importance table in 3.1.2 and combined with the research content of this paper, the following relative risk table can be established:

Table 2. Relative risk and score

meaning		Scale Cij
Cij	Very dangerous	9
	Very dangerous	7
	More dangerous	5
	A bit dangerous	3
	As dangerous	1
Cji	A bit dangerous	A third
	More dangerous	1/5
	Very dangerous	1/7
	Very dangerous	1/9
The above two adjacent judge the median value		8, 6, 4, 2, 1/2, 1/4, 1/6, 1/8
Not sure		N/A

$$A = \begin{bmatrix} 1 & \frac{7}{9} & \frac{5}{9} & \frac{5}{9} & \frac{3}{9} & \frac{1}{9} \\ \frac{9}{7} & 1 & \frac{5}{7} & \frac{5}{7} & \frac{3}{7} & \frac{1}{7} \\ \frac{9}{5} & \frac{7}{5} & 1 & \frac{5}{5} & \frac{3}{5} & \frac{1}{5} \\ \frac{9}{5} & \frac{7}{5} & \frac{5}{5} & 1 & \frac{3}{5} & \frac{1}{5} \\ \frac{9}{3} & \frac{7}{3} & \frac{5}{3} & \frac{5}{3} & 1 & \frac{1}{3} \\ \frac{9}{1} & \frac{7}{1} & \frac{5}{1} & \frac{5}{1} & \frac{3}{1} & 1 \end{bmatrix}$$

Establish the Judgment Matrix

A judgment matrix refers to any system analysis based on certain information. The information basis of AHP is mainly people's judgment on the relative importance of each factor at each level. These judgments are expressed by numerical values and written into the results in the form of a matrix. The judgment matrix is the starting point of AHP work, and the construction of the judgment matrix is the key step of AHP.

First-level indicator judgment matrix:

$$R = \begin{bmatrix} 1 & \frac{3}{4} & \frac{3}{4} \\ \frac{4}{3} & 1 & 1 \\ \frac{4}{3} & 1 & 1 \end{bmatrix}$$

This matrix is about the relative importance of first-level indicators

Second-level indicator judgment matrix:

Among them, the injured part

This matrix compares the danger degree of different parts in skydiving

$$B = \begin{bmatrix} 1 & \frac{6}{7} & \frac{5}{7} & \frac{3}{7} \\ \frac{7}{6} & 1 & \frac{5}{6} & \frac{3}{6} \\ \frac{7}{5} & \frac{6}{5} & 1 & \frac{3}{5} \\ \frac{7}{1} & \frac{6}{3} & \frac{5}{3} & 1 \end{bmatrix}$$

This matrix compares the risk of various external factors

$$C = \begin{bmatrix} 1 & \frac{3}{6} & \frac{1}{6} \\ \frac{6}{3} & 1 & \frac{1}{3} \\ \frac{6}{1} & \frac{3}{1} & 1 \end{bmatrix}$$

This matrix compares the degree of risk caused by the different factors that the skydiver himself has.

Consistency Test

According to 3.1.2, the consistency test is conducted on the first-level judgment matrix R.

$$CI=3-3/3-1=0$$

$$CR=0$$

By test, the judgment matrix R satisfies the

consistency condition.

The consistency test of the secondary judgment matrix A is carried out.

CI=0

CR=0

After testing, the judgment matrix A satisfies the consistency condition.

The consistency test of the secondary judgment matrix B is carried out.

CI=0

CR=0

By test, the judgment matrix B satisfies the consistency condition.

The consistency test of the secondary judgment matrix C is carried out.

CI=0

CR=0

By test, the judgment matrix C satisfies the consistency condition.

Determine the Weight of Indicators

According to formula (3) in 3.1.3, the weight of each indicator is calculated, and the weight values of the above indicators are integrated into the following table:

Table 3. Weight values of each index

Level indicators	injury		External factors			Internal factors
Level 1 weight	0.4		0.3			0.3
The secondary indicators	The ankle	The limbs	Shoulder joint	The hip joint	The lumbar spine	The spine
Secondary weights	0.120	0.092	0.068	0.068	0.040	0.012
The secondary indicators	experience		age		gender	psychological quality
Secondary weights	0.099		0.087		0.072	0.042
The secondary indicators	terrain		The weather		highly	
Secondary weights	0.180		0.090		0.030	

Quantitative Analysis of Indicators

The expert scoring method is also a qualitative description and quantitative method. It firstly selects several evaluation items according to the specific requirements of the evaluation objects, and then formulates evaluation criteria according to the evaluation items. A number of representative experts are hired to give the evaluation scores of each item according to the evaluation criteria based on their own experience and then aggregate them. <http://www.managershare.com/wiki/%E9%A1%B9%E7%9B%AEhttp://www.managershare.com/wiki/%E8%AF%84%E4%BB%B7%E6%A0%87%E5%87%86>The expert scoring method is very simple, through determining appropriate evaluation items according to specific evaluation objects, to formulate evaluation levels and standards. And has a strong intuition, each grade standard can be reflected in the form of scoring. And the calculation method is simple, and the choice is relatively large. This method can also take into account both the evaluation items that can be quantitatively calculated and the evaluation items that cannot be calculated. In this study, the expert scoring method was used to score each index.

Determine the Risk Level

AHP was used to determine the weight of each indicator and an expert scoring method was used to determine the score of each indicator. Now the

risk grade table is constructed as shown in Equation (1). Suppose the danger of skydiving is R, and the value of R ranges from 1 to 100. When R is greater than 90, the risk level is very dangerous; when R is between 80 and 90, the risk level is very dangerous; when R is between 70 and 80, the risk level is dangerous; when R is between 60 and 70, the risk level is dangerous; when R is less than 60, the risk level is not dangerous. See Table 1 for details.

Table 4. Danger grade table of skydiving sports

Skydiving is dangerous	R 90 or more	80 or less R < 90	70 or less R < 80	60 acuties were R < 70	R < 60
Hazard level	Very dangerous	It is dangerous to	dangerous	There are dangerous	Not dangerous

Example

Examples can be used to test whether the evaluation system is reasonable Hazard analysis of a 30-year-old male novice parachuting in windy weather, with no prior parachuting experience and no similar experience, landing on a platform in a tense descent from 5000 m in wind speeds of 22 MPH. Different factors are awarded different points, which determine the degree of risk posed by different factors

The ankle has to bear the weight of the whole body when it hits the ground, so it is 93 points. Healthy adults, whose limbs are more powerful and require a lot of impacts, are less vulnerable to injury, scoring 87. The shoulder and spine are not directly affected by the impact of the landing, but can be injured because of the deformation of the movement, so both are 75 points. The hip joint is also directly impacted by the landing, but it's more stable than the ankle, so it's 91 points. Most modern people often sit for a long time, so people's lumbar spine is generally not good, so the probability of injury is greater than the spine, so the score is 78 points. Beginners have little practice and no combat experience, so the danger score is 85. Men are normally stronger, and the

skydiver in this example is at his strongest age, so the score is 70. The parachutist is in a state of stress, psychological quality is not good, so the psychological quality of the danger score is 83 points. Landing terrain is a platform, a very common landing position, except for special circumstances is difficult to be dangerous, the score is 65 points. The weather was very windy and dangerous for skydiving, so the score was 97. Skydiving is more common, but still high for beginners, so the score is 70 points.

Table 5. The example

indicator s	The ankle	The limbs	Shoulder joint	The hip joint	The lumbar spine	The spine	experience	age	gender	The psychological quality	terrain	The weather	highly
The weight	0.12	0.09	0.07	0.07	0.04	0.01	0.10	0.09	0.07	0.04	0.18	0.09	0.03
score	93	87	75	91	78	75	85	70	70	83	65	97	70
Total score	80.03												

This example proves that the system is reasonable.

Conclusion

Through this article, some information and conclusions about the risk factors of skydiving are summed up

(1) By reading literature and combining with a large number of parachuting accidents that have occurred, this paper made statistics on injured people, injury sites, injury types, and clinical manifestations, and analyzed the corresponding injury causes and treatment plans, providing a reference for the subsequent establishment of parachuting risk index system.

(2) The risk evaluation system of parachuting sports is established, in which the weight of each index is determined by the analytic hierarchy

process, and the quantitative analysis of each index is carried out by an expert scoring method. Finally, the risk level of specific parachuting sports is determined by comparing it with the grade division table.

(3) The steps of the analytic hierarchy process are as follows. The user should divide the objective of decision-making, factors to be considered (decision-making criteria), and decision-making objects into the highest, middle, and lowest levels according to their mutual relationship, and draw the hierarchical structure diagram. The top tier refers to the purpose of the decision and the problem to be solved. The lowest level refers to the alternatives when making decisions. The middle layer refers to the factors to consider, and the criteria for decision making. For the two adjacent layers, the upper layer is the target layer and the lower layer is the factor layer.

(4) Through analysis, the researchers believe that the injury site needs the most attention, and the ankle joint is the most vulnerable part, but the spine is more stable and less vulnerable to injury. However, the injury caused by lack of experience is the most common internal factor, while the psychological quality is relatively irrelevant. At the same time, among many external factors, the damage caused by the complicated terrain during landing accounted for the majority, but the height of the jump had no effect on the damage.

(5) the research examines, analyzes, and scores an example of the proposed indicators. And the final score successfully verified the rationality of the skydiving risk evaluation system.

Advice

(1) Skydivers, according to the risk evaluation system of skydiving, skydivers' ankles are most vulnerable to injury. It is recommended to wear

protective equipment to protect ankle joints and carry out professional training many times before jumping, so as to avoid major accidents or injuries caused by lack of experience.

(2) However, this evaluation system also proves that most parts of the body may be injured in sports, so training institutions should do a good job in the comprehensive protection of students, not only should provide a full set of protective equipment, but also should do the best in all the learning or training items to avoid injuries due to incomplete knowledge and skills of students. And regularly check the equipment and site indicators are up to standard, to avoid damage caused by external factors.

(3) While ensuring the quality of products, protective equipment manufacturers should also provide instructions for the use of their products to ensure that users can use them correctly and make protective equipment play a role.

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