

# *Research on the Characteristics and Prevention Strategies of Hurdling Sports Injuries in School Physical Education*

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**Keywords:** Hurdling, School physical education, Sports injury, Teaching method, Health

**Abstract:** Hurdling is an important part of physical education in colleges and universities. This form of sport requires students to continuously cross a certain number and height of hurdles while running, which has the characteristics of high intensity and technical requirements and the requirements for students' physical and mental qualities. In the process of hurdling, there are many factors that can affect the students' movement state, and it is very easy to cause sports injuries, which will not only cause damage to students' body, but also make students fear of hurdling. Based on this, this paper uses literature, interviews and other scientific research methods to analyze the technical characteristics, the injury characteristics and the influencing factors of hurdling, explore the prevention strategies. It was found that the sports injuries suffered by students in hurdles mainly occurred in the over hurdle and landing phase, often in the lower limb parts such as ankle and knee joints, mainly sprains, contusions and abrasions. Project characteristics, training arrangements, athletic level, physical quality and emotional psychology are the main influencing factors for students to cause sports injuries in the hurdles teaching process. In view of this, it is suggested that before teaching, physical education teachers should pay attention to preventive screening and properly arrange training intensity; during teaching, scientific arrangement of preparation activities and good sports medical supervision; after teaching, students should strengthen functional training and pay attention to post-training recovery.

## **1. Introduction**

Hurdling is one of the most complicated items in the school physical education work. As a kind of short-distance event, hurdle running itself requires high physical and psychological quality of the athletes, and because of the complexity of its technical movements, it also requires the teacher to have a certain level of teaching. Hurdling technical action has the characteristics of transient, complex and high intensity, but also requires students to have the courage to overcome obstacles, the coordination of action articulation and the sensitivity of grasping the timing. Because of the need to continuously cross the obstacles in the process of high-speed running, it is very easy for

sports injuries to occur during the teaching, training and competition of hurdling. Based on this, this paper uses literature, interviews and other scientific research methods to analyze the technical characteristics, the injury characteristics and the influencing factors of hurdling, explore the prevention strategies, in order to provide theoretical reference for the time of physical education of hurdling, reduce the probability of hurdling injury, and ensure that hurdling can be used in school physical education. The purpose is to provide theoretical reference for the teaching time of hurdling, to reduce the occurrence rate of hurdling injury, so as to ensure the healthy development of Hurdling in school sports.

## **2. Analysis on Hurdling Technical Characteristics**

For the convenience of research, academics usually classify the movement techniques of Hurdling into four types by phase: starting technique, over hurdle technique, inter-hurdle technique, and sprint technique <sup>[1]</sup>.

### **2.1. Starting Technique**

The starting technique of hurdling is basically the same as sprinting, but in the process of reviewing the literature, I found that some scholars believe that the starting technique of hurdles has some differences with sprinting, so we can't simply think that the two techniques are similar <sup>[2]</sup>. The starting technique of sprinting needs to depress the body to speed up the arm swing in order to obtain sufficient initial speed, while hurdling should lift the upper body quickly after the start to the first hurdle to prepare for the first hurdle. Therefore, the starting technique of hurdling should regard the posture of accelerating to the first hurdle as a whole. Generally speaking, the number of steps used to start to the first hurdle starting point varies from person to person. Professional athletes commonly use seven steps or eight steps. In the college classroom teaching process, due to the different athletic ability of students, the number of steps from the start to the first hurdle can be changed according to the situation, and eight or nine steps can be used to start.

### **2.2. Over Hurdle Technique**

The over hurdle technique refers to the action technique between the foot of the starting leg from stepping on the starting point and the foot of the swing leg landing after crossing the hurdle, which is the main link of the hurdle teaching process. This technique connects the two technical actions of hurdling and landing running, and plays the role of connecting the preceding and the following in the whole hurdle running process. In addition, over hurdle technique is divided into 3 stages: starting hurdle, hurdling, and landing. In the starting phase, in order to maintain a high speed, when the starting leg lands on its feet, the swing leg should be folded quickly from the back to swing forward, the knee joint is raised above the waist. At the same time, the upper body leans forward, the opposite hand of the swing leg swings forward and up, the other arm bends the elbow to the side of the body, forming hurdling posture. In the hurdling phase, the body's center of gravity should move forward with hurdling posture, after the starting leg stirrups off the ground, the swing leg continues to swing forward over the height of hurdle, and the lower leg actively swing forward to press the hurdle frame. In the landing phase, the swing leg should be actively pressed down, and the starting leg should be accelerated and lifted to the hip joint as the axis to do the shearing and twisting posture. When the swing leg over the hurdle frame, the starting leg quickly folded knee abduction hook toe, knee higher than the ankle, to knee leading through the armpit forward lifting in place.

### 2.3. Inter-hurdle Technique

The inter-hurdle technique refers to the technical action between the two hurdles, refers to the technical action characteristics shown in the distance from the swing leg after the hurdle to the starting foot on the starting point. The main task of the inter hurdle running stage is: as far as possible to increase the rhythm between hurdles, improve the running speed, to create the necessary prerequisites for the next hurdle. Under the condition of fixed height and fixed distance, the interval running also formed a special number of steps, step frequency, step length and other technical characteristics different from sprinting<sup>[3]</sup>. The first step of inter-hurdle running is the smallest, its distance is about 1.60 meters, and its task is to change the hurdling action into flat running action as soon as possible, to lay a good foundation for the rhythm and speed of inter-hurdling running. The reason for the small first step is that the vacating time is longer when crossing the hurdle, the vacating height is higher, and the speed drop is larger; there is almost no cushion for the knee joint when going down the hurdle, and the backstroke cannot give full play to the strength of large muscle groups; the starting leg is pulled forward from the side of the body, reducing the power and amplitude of the forward swing; the angle of the backstroke is larger than the angle of the flat run. For this reason, in order to get the necessary stride length in the first step, we should give full play to the power of the ankle joint in the backstroke, and rely on the positive forward swing of the starting leg to get the required stride length, to ensure the speed and rhythm of inter-hurdle running. The second step length of inter-rail running is the largest, and its step length is about 2.10 meters. From the action appearance, this step has been basically close to the sprint technique of sprinting, which is due to the fact that at this time the athlete's running has eliminated the influence of action conversion on the athlete, the athlete's main focus on trying to get the step speed. The third step of running between the hurdles step length is medium, the step length is about 1.95 meters. This is closely related to the starting hurdle phase, the athlete at this time to make difficult preparations for the starting hurdle, the action is characterized by the swing leg down actively, the landing point is close to the center of gravity projection point, the center of gravity is in a higher position, the ups and downs are not obvious, the speed reached the highest point.

### 2.4. Sprint Technique

Sprint technique refers to the moment of the tenth hurdle to the end of the running technology. Similar to the sprint event, hurdles project in the end of the sprint running stage also exists line pressing technique. In the tenth hurdle, the athlete need to adjust the posture and body state, swing the moment of leg drop, body weight quickly adjust to a reasonable position, two arms actively swing to drive the body forward, rushing to the finish line before the upper body actively lean forward, so that the torso first pressure line.

## 3. Research on Injury Characteristics in Hurdling

Understanding the characteristics of common injuries in hurdle teaching and training is an important prerequisite for analyzing the causes of injuries and proposing injury prevention strategies. Based on the author's years of experience in hurdles and long-term hurdles training, I found that the common sports injuries in hurdles teaching and training have the following main characteristics:(1) the injury phase is mainly concentrated in the hurdle and landing phase; (2) the injury type is mainly sprains, contusions and abrasions; (3) the injury parts are mainly concentrated in the lower limb parts such as ankle joint and knee joint.

### 3.1. Research on Injury Stage Characteristics in Hurdling

Generally speaking, students in starting stage, over hurdle stage, inter-hurdle running stage, sprint stage of hurdling may occur sports injuries, as shown in Table 1. In the starting stage, inadequate preparation or poor starting technique is a common cause of injury; in the over hurdle stage, the occurrence of sports injuries is more due to students' own unskilled technique on the hurdles; in the landing stage, students often injure their knees or ankles due to unskilled technique or poor joint strength; in the inter-hurdle stage, it is mainly due to unreasonable stride length and frequency and lower limb strength. A study found that the stages leading to student injuries were mainly concentrated in the 2 stages of hurdle crossing and landing, with injury ratios reaching 65.00% and 57.50% respectively. The reason for this analysis is that the two techniques of over hurdles and landing require the completion of difficult body postures during the movement, which have high requirements for students' physical qualities such as strength, coordination and flexibility.

Table 1: Investigation of injuries in each technical movement phase of hurdling

Technical movement phase	Number of people	Percentage
Starting stage	110	55.00
Over hurdle	130	65.00
Down the hurdling / landing	115	57.5
Inter-hurdle running phase	60	30

Note: The data were obtained from "Investigation and Prevention Study on Sports Injuries of CrossFit Running in Physical Education", Sport, 2018.12.

### 3.2. Research on Injury Type Characteristics in Hurdling

During the teaching of hurdle running, sprains were the most common type of injury, while abrasions and contusion were in the second and third places respectively, and the probability of lacerations was relatively small, as shown in Table 2. Sprains mainly occurred in the ankle joint, mainly because the talar slide is a "narrow front and wide back" trapezoidal anatomical structure, which makes the ankle joint in dorsiflexion is very easy to occur excessive inversion and valgus, and because the medial triangular ligament of the ankle joint is more protective than the lateral ligament, so the probability of inversion is much higher than the probability of valgus <sup>[4]</sup>. Ankle instability is also one of the main causes of abrasions and bruises. In hurdles, due to the lack of ankle muscle strength and body movement coordination, students lose their balance and fall or collide due to the deviation of the force point when landing, thus causing bruises or bruises. Lacerations often occur in the over hurdle stage, the reason is mainly due to the inadequate completion of the students' pre-course preparation activities, resulting in memory injuries to the thigh extension muscle group of the starting leg and the suture muscle group of the swing leg when hurdling. In addition, because the field is too hard or action mastery is not in place, there are often students in a period of hurdle running training after the calf neck side near the ankle side of the severe pain, medical called fatigue periostitis of tibial and knee bone.

Table 2: Statistical table of injury types in the course of hurdling

Type of injury	Number of injuries	Percentage
Lacerations	41	20.31%
Bruises	63	31.25%
Twist	125	62.5%
Contusions	84	42.19%
Abrasion	84	42.19%

Note: Data from "Investigation and Prevention Study of Sports Injuries in Hurdle Running in Physical Education", Sport, 2018.12.

### 3.3. Research on Injury Parts Characteristics in Hurdling

Hurdling injuries frequently occur below the knee joint, with ankle and knee injury rates as high as 59.5% and 44%, respectively, as shown in Table 3, which is closely related to its unique anatomical characteristics. The ankle joint, also known as the talocrural joint, is a typical talocrural joint with the functions of dorsiflexion, plantarflexion, and internal and external rotation. The stability of the ankle joint is maintained mainly by its surrounding ligaments, and sprain of the lateral collateral ligaments is most common in the plantarflexion inversion position. In hurdling, poor coordination, balance, flexibility and other qualities, poor ankle muscle strength, and hard ground in the training ground may lead to unstable body weight when the student lands on the ground, and the body is biased to one side so that the lateral side of the foot lands first, thus causing ankle injury. The structure of the knee joint is characterized by the medial and lateral collateral ligaments that reinforce the knee joint to limit internal and external rotation, and the anterior and posterior crosses that limit excessive anterior or posterior displacement of the tibia <sup>[5]</sup>. The peripheral ligaments play a critical role in maintaining knee stability, but are also one of the most common sites of injury for students. The medial collateral ligament is generally tough and is taut in maximum extension or flexion of the knee, and generally does not cause injury. However, during hurdle running, the knee joint is in a semi-flexed position when vacating over the hurdle, and the medial collateral ligament is under tension, which can easily lead to injury. In addition, although the anterior cruciate ligament itself has a strong toughness, but students often focus too much attention on the knee joint and ignore the follow-up action when crossing the hurdle frame, it is easy to lead to the occurrence of ACL tear or rupture <sup>[6]</sup>.

Table 3: Statistical table of injury parts of hurdle

Injury site	Number of injuries	Percentage
Gluteus maximus	20	10.0 %
Posterior femoral muscle group	78	39.0 %
Knee joint	88	44.0 %
Fatigue periostitis of tibial and knee bone.	66	33.0 %
Achilles tendon	5	2.5.0%
Ankle joint	119	59.5%

Note: The data were obtained from "Investigation and Prevention Study on Sports Injuries of CrossFit Running in Physical Education", Sport, 2018.12.

#### 4. Research on the Factors Affecting Sports Injuries in Hurdling during the Teaching Process

In the process of physical education, the factors that can cause sports injuries are multifaceted, according to the collation of relevant domestic literature and combined with the author's practical experience, that the main causes and the characteristics of the hurdling itself, training program arrangements, as well as the students' own level of competition, physical fitness, emotional psychological and other aspects of a certain degree of contact, specific injuries are mainly the following types, as shown in Table 4.

Table 4: Statistical table of causes of sports injuries in physical teaching process

Cause of injury	Percentage of injury occurrence
Inadequate preparation activities	19.36%
Error in hurdling technique	29.03%
Excessive exercise or fatigue of the body	13.71%
Not mentally prepared or depressed	8.06%
Weather, venue and other environmental factors	6.45%
Poor physical fitness	9.68%
Improper organization of teachers	4.84%
Accidents	8.87%

Note: Data from "The occurrence pattern and prevention of hurdle sports injuries", Teaching of Forestry Region, 2015.8.

##### 4.1. Research on the Effect of Project Characteristics on Sports Injury in Hurdling

In the field of sports training, the occurrence of common sports injuries usually has a certain relationship with the characteristics of the sport <sup>[7]</sup>, and this is also true for hurdling. The causes of common sports injuries in hurdles teaching and training also have a certain relationship with the characteristics of hurdles. Take the common injuries in daily school physical education as an example, in the hurdling teaching process, common sports injuries often occur in the knee, ankle and other lower limb parts, the main reason is that in the hurdles project, participants need to run in the process of continuous completion of multiple jumping, attacking the bar, air, crossing, landing, down, landing action, and these technical movements have the characteristics of transient, continuous. According to the data of sports biomechanics, when completing this series of movements, the lower limbs need to continuously bear 2-4 times the weight of the participant's pressure, and due to the peculiarities of human physiological structure, the physiological anatomy of the knee and ankle joints has a certain instability, and the participants should have strong lower limb strength, otherwise it is very easy to happen joint sprains and other accidents, which affects the teaching effect of teachers and the participants' training effect is also affected.

##### 4.2. Research on the Effect of Training Arrangement on Sports Injury in Hurdling

Combined with the relevant literature, from the training program level, to explore the common causes of sports injuries in hurdling, we can find that the factors that cause sports injuries mainly include preparation activities, training intensity, recovery and relaxation <sup>[8]</sup>. First, the preparation activities before training are not scientific. The preparation time is too short, the preparation time is too long from the formal training, and the preparation content lacks relevance and specificity, which



will affect the effect of the participants' preparation activities. In such a state to carry out hurdling teaching training, because the participants do not get fully warmed up, resulting in the body parts of the muscle temperature continues to be low, the function of the system and organs cannot be fully mobilized, greatly increasing the incidence of sports injuries. Secondly, the load intensity in training is unreasonable. Some teachers in the teaching process in order to pursue the teaching and training progress, often ignore the size of the student's ability, blindly arrange some load intensity, load a large amount of teaching and training activities, for the occurrence of sports injury accidents laid a hidden danger. In addition, the recovery after training relaxation is not sufficient. After the high-intensity, large load of teaching and training activities, arrange students to relax and recovery is a necessary part of training. Hurdling has the characteristics of fast speed, complex technology and high intensity, if students do not take effective relaxation and recovery measures after training, with the accumulation of fatigue, the body function will appear a series of adverse physiological reactions, eventually leading to sports injuries and sports function decline. Scientific and reasonable recovery process not only helps to avoid the occurrence of sports injuries, but also is the key to stimulate the body to recover in excess. However, the lack of systematic knowledge of sports medicine and the necessary practical skills of protection makes most teachers currently unable to take on the role of sports protection teacher.

#### **4.3. Research on the Effect of Competitive Ability on Sports Injuries in Hurdling**

In the teaching activities of general physical education, students' poor understanding of specific technical movements of hurdles is also one of the main causes of sports injuries<sup>[9]</sup>, and for hurdles, such problem is even more serious. According to the interviews with front-line teachers and students who take hurdles, in most schools, only half a semester's time is allocated to hurdles, and after the basic techniques are explained, there is little time for students to consolidate practice, so it is difficult for students to master the technical movements of hurdles with class time, especially the "cut and twist" on the back hurdles. Posture" of the attacking action, in the hurdle to do a good start leg active forward, swing leg size leg folding knee abduction to knee leading through the armpit lifting in place. This technical action requires participants to repeatedly practice, and physical quality to achieve a certain to be able to make the standard posture in the actual operation process, so as to reduce the probability of sports injuries through the standardization of technical action.

#### **4.4. Research on the Effect of Physical Fitness on Sports Injuries in Hurdling**

Hurdles project has a complex sports technology system, fast-paced movement frequency and high-intensity sports load, the sensitivity, speed, endurance, strength, flexibility quality requirements of the participants are high, but also because of this reason, good physical quality is also one of the key conditions to prevent sports injuries, reduce the probability of injury<sup>[10]</sup>. If a physical quality of the participants to the requirements of the technical action, it is likely to lead to the occurrence of sports injuries, to flexibility quality, for example, join the participant flexibility quality does not meet the requirements of sports technology, then in the technical action may appear in error, the wrong technical action is one of the factors that cause sports injuries, will increase the probability of strains, bruises, sprains; on the contrary, when On the contrary, when the participants' flexibility quality reaches the standard, their own body control ability can also be strengthened to a certain extent, which can enhance their resistance ability and make the technical movements more in line with the norms, reducing the probability of sprains, bruises and other sports injuries.

#### **4.5. Research on the Effect of Emotional Psychology on Sports Injuries in Hurdling**

The hurdling requires participants to cross multiple obstacles continuously, its technical movements have a certain complexity and difficulty, requiring participants to have high physical quality, in the actual teaching process, often occur due to the technical difficulty and students' physical quality mismatch caused by sports injury accidents, which can cause negative psychological pressure on students, causing fear<sup>[11]</sup>, affecting the teaching and training state. Many teachers and students only focus on the technical level, environmental level, training level factors that can easily lead to sports injury accidents, the lack of neglect of the participants' emotional level, tension or not, anxiety or not and other psychological state, which is also an important cause of sports injury accidents in the current school physical education. Take the participants' emotion as an example, when the emotion is low, it will often cause the concentration level and attention duration to decrease, when the participants' attention is not concentrated, ignore their psychological state and force them to participate in the hurdle project, it will undoubtedly increase the probability of sports injury accidents.

#### **5. Research of Prevention Strategy of Sports Injuries in Hurdling**

##### **5.1. Pre-teaching: Attention to Preventive Screening and Proper Arrangement of Exercise Intensity**

Understanding students' athletic ability and physical fitness level is the first step of physical education, and scientific athletic ability testing and sports injury screening play an irreplaceable role in the subsequent teaching of hurdling skills<sup>[12]</sup>. FMS functional movement screening is a human ability assessment method, which can detect the basic human movement pattern disorders or defects at an early stage, and is widely used in the assessment of athletic ability of professional athletes in the U.S.<sup>[13]</sup>. The FMS test is based on the basic functional movements of the human body and consists of three tests: movement patterns, flexibility, and stability. Before teaching or training, teachers can monitor the symmetry, flexibility, stability and limitations of students' bodies through FMS test to play a preventive and protective role, and at the same time, conduct targeted training for the weak links of students' physical qualities and carry out corresponding movement training to improve the flexibility and stability of the body in order to reduce the possibility of injury occurring during the learning and training process.

Reasonable design of scientific and reasonable training plans to ensure that students are as safe as possible to strengthen their physical fitness training and psychological quality training. On the one hand, according to the individual differences of students, for example, age, physique, physical condition and so on to develop different physical training plan. On the other hand, physical teachers also pay attention to the psychological quality training, the students' psychological quality training reasonable throughout the teaching and training activities, and gradually improve the students' psychological quality, for example, attention training, phenotype training, etc. are the psychological training methods can be referred to. Teachers should pay attention to the reasonable arrangement of the exercise load, and to eliminate the practice of rapid success and blind adventurism.

##### **5.2. Teaching Time: Scientific Arrangement of Preparation Activities and Reasonable Sports Medical Supervision**

To ensure the scientific arrangement of hurdling teaching and training, should address the causes of sports injury accidents triggered at the training level<sup>[14]</sup>, should start from two aspects:



preparation activities and sports medical supervision. To ensure the effective implementation of preparatory activities, we should pay attention to avoid both the short preparation time, too long interval from the formal teaching training, the lack of specificity of the content of the activity so that the lack of preparation effect, but also pay attention to avoid the problem of too long preparation time, otherwise it is too late, before entering the formal teaching and training session, students will appear athletic fatigue, but will increase the sports injury occurrence. Before the hurdles teaching training, teachers should conduct safety inspection for the teaching training site and teaching training equipment to be used in advance, and deal with the safety hazards as soon as they are found. In addition, should also pay attention to do a good job of medical supervision, especially in the case of harsh weather conditions to carry out hurdling teaching training, more should do the necessary medical measures in advance, as far as possible to minimize the incidence of sports injuries and injury hazards.

### **5.3. Post-Teaching: Strengthen Functional Training and Pay Attention to Post-training Recovery**

Students are prone to sports injuries after training with high load intensity and load, while functional training can be effective enough to improve the trainer's physical fitness, while also playing a positive role in improving flexibility, agility, balance and coordination, which can effectively prevent the occurrence of sports injuries in hurdling teaching <sup>[15]</sup>. Therefore, while carrying out special training, teachers must arrange appropriate functional training for students to improve their physical quality and reduce the risk of sports injuries. Core zone muscle group training can improve students' core zone joint stability, enhance body coordination and improve muscle power functional chain, which can effectively prevent sports injuries in hurdling teaching. In hurdling, students' rapid force can give full play to the role of core muscle groups to maintain the position of limb movement and achieve the protection of limbs. In order to avoid knee injuries caused by knee abduction and adduction, and low back injuries caused by excessive back swing of the same side of the starting leg, strength training can be carried out with the help of training equipment such as swiss ball and balance board to enhance the muscle strength of the core muscle groups to stabilize the limb, so as to effectively prevent the occurrence of sports injuries.

Teachers should organize and supervise students to recover after training scientifically. After the completion of training, students should be reminded to eat more fresh fruits and vegetables, timely replenishment of vitamins and proteins to provide material basis for energy substance recovery and body metabolism, and promote the recovery of students' fatigue. In addition, after the completion of hurdling, students will inevitably experience nerve tension, accelerated breathing and elevated heart rate, as well as contraction reflexes and fatigue of muscles, joints and ligaments, and even cause spasms. Physical education teachers should continue to expand their scope of practice and learn some of the practical sports protection techniques needed for the physical education process, either by themselves or through unified training. During training, they can provide basic safety for students' training, and after training sessions, they can also organize relaxation and convalescence activities such as massage to speed up students' fatigue recovery.

## **6. Conclusions**

To sum up, in the teaching process, we should strengthen teachers' psychological education to students by conducting research before, during and after teaching, so that they understand the causes of sports injuries and their hazards, and make the concept of injury prevention deeply rooted in people's hearts. While teachers should also strengthen research on the teaching content of preparation activities, teaching sequence, exercise load, etc. According to the characteristics of the

project and the local climate to reasonable arrangement of teaching steps, teachers ought to organize good warm-up activities, help students to establish the correct technical concept, master the essentials of action, correct the wrong technical action. At the same time, we should also strengthen the safety inspection of the field equipment, increase the configuration of protective measures, do a good job of sports supervision and preventive screening before exercise to ensure the safety of teaching and training, so as to ensure that the hurdles project can be in the process of benign development of physical education in schools.

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