

Research on the Characteristics of Sports Injuries and Prevention Strategies among Traditional Chinese Opera Actors Based on Epidemiological Investigation

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Abstract: This study conducted an epidemiological investigation into sports injuries among traditional Chinese opera actors, revealing a significant prevalence of such injuries with an overall incidence rate as high as 92.57%. Chronic injuries accounted for a higher proportion than acute injuries, and some chronic injuries originated from acute injuries. The lumbar region, ankle joint, and knee joint are the anatomical areas most susceptible to sports injuries in traditional Chinese opera actors. Traditional Chinese opera actors are most susceptible to acute injuries when performing jumping or flipping movements, and the incidence of sports-related injuries is particularly higher at the moment just before the completion of these actions. Sports injuries are more likely to occur during daily training than during stage performances, with the middle phase of training sessions being more prone to injury than the initial and concluding phases. Finally, to better prevent sports injuries among traditional Chinese opera performers, this study proposes several strategic scientific prevention recommendations from multiple dimensions, including the establishment of a comprehensive sports injury prevention system, professional training for instructors, physical and mental recovery after exercise, digital teaching methods, post-injury rehabilitation therapy, and enhanced psychological training.

Keywords: Sports Injuries; Traditional Chinese Opera Actors; Physical Training; Rehabilitation Strategies

1. Introduction

Physical training constitutes a fundamental component of daily performance learning for

Traditional Chinese Opera Actors, yet sports injuries frequently occur during such training [1,2]. These injuries have become a persistent obstacle to the improvement of performing skills and impose constraints on the long-term development of performers' artistic careers [3]. Given that opera education programs do not systematically incorporate instruction in human biology, medicine, or kinesiology, there is a notable lack of scientific guidance for injury prevention. Therefore, a systematic investigation into the issue of sports injuries among Traditional Chinese Opera Actors is urgently warranted. Epidemiological survey represents a commonly adopted research paradigm in the study of sports injuries; accordingly, the present study employs this approach. A total of 296 opera performance majors (141 males and 155 females) were recruited from institutions including the National Academy of Chinese Theatre Arts, its Affiliated Secondary School, and Beijing Vocational College of Opera. A systematic survey was conducted to document the injury profiles, summarize the distribution characteristics of sports injuries, and analyze the contributing factors based on the epidemiological triangle model (comprising host variables, environmental variables, and mediating variables). On this basis, preventive strategies for sports injuries in Traditional Chinese Opera Actors are proposed.

2. Characteristics of sports injuries in Traditional Chinese Opera Actors

2.1 Incidence of Sports Injuries

The sports injuries defined for Traditional Chinese Opera Actors in this study refer to all injuries requiring medical attention that occur during physical performance or training activities conducted by Traditional Chinese

Opera Actors on stages, in practice rooms, or other designated venues. The investigation revealed that a total of 272 individuals had sustained injuries, accounting for 92.57%, while only 22 individuals (7.43%) had no injuries. Among them, the number of male and female injured individuals was 135 and 139 respectively, representing 45.61% and 46.96% of the total. In terms of the frequency of injuries, the highest number of cases (176 individuals) occurred with 1–3 injuries, accounting for 59.45%; followed by those with ≥ 6 injuries (53 individuals, 17.91%); and 45 individuals experienced 4–6 injuries, representing 15.21%. When analyzing separately for male and female groups, the highest frequency was observed in cases occurring 1–3 times.

2.2 Types and Sites of Injury

Based on disease progression classification, sports injuries can be categorized into acute injuries and chronic injuries (also referred to as overuse injuries). The investigation revealed a total of 421 cases of sports-related injuries. Chronic injuries were the most prevalent, accounting for 267 cases (63.37%), while acute injuries comprised 154 cases (36.63%). Among these cases, 91 instances of chronic injuries resulted from acute injuries, accounting for 34.08%.

Statistical analysis of injury sites revealed that the top three most frequently affected areas were the lumbar region (spine), ankles, and knees, with 101 cases (23.99%), 76 cases (18.05%), and 67 cases (15.91%) respectively. These findings align with the subjective perceptions of professionals in the traditional Chinese opera industry regarding current injury patterns within the field. The distribution across other anatomical sites was as follows: wrist (39 cases, 9.26%), elbow (28 cases, 6.65%), shoulder (24 cases, 5.70%), lower leg (22 cases, 5.23%), thigh (20 cases, 4.75%), hip (19 cases, 4.51%), fingers (16 cases, 3.80%), toes (6 cases, 1.43%), and head/neck (3 cases, 0.71%).

2.3 The Sports Injury Occurred while the Opera Performer Was Performing a Specific Movement

Based on the external characteristics of theatrical physical performance movements, they can be classified into balance-based types, jumping types, flipping types, and combined jumping-flipping types [4]. Statistical analysis of

acute injuries across various movement types revealed that jumping and flipping maneuvers (accounting for 37.18%) were the most common cause of sports-related injuries, followed by jumping maneuvers (30.03%) (Figure 1).

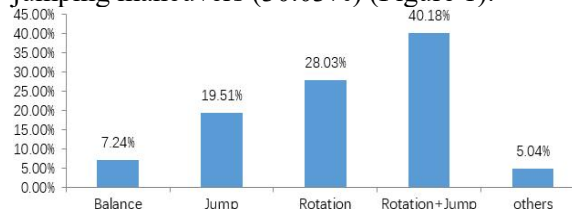


Figure 1. Probability of Sports Injuries Occurring with Various Types of Movements

2.4 Timing of Sports Injury Occurrence

The timing of acute injury occurrence was investigated. First, statistical analysis was conducted across two dimensions: daily training under the training platform and performances on stage. The incidence of sports injuries was significantly higher in the former group (94.4%). Secondly, by analyzing injuries across three dimensions—beginning, middle, and end of each training session—we conducted a statistical analysis of injury occurrence timing during daily sessions, revealing that injuries were most frequently occurring during the middle phase (51.88%). The proportions of the beginning and ending parts are respectively 18.05% and 30.08%. Finally, individual performance movements were further categorized into the initiation phase, intermediate phase, and concluding phase for statistical analysis. The intermediate phase (accounting for 37.96%) and the concluding phase (accounting for 38.69%) of movement execution exhibited a higher incidence of acute injuries.

In conclusion, sports injuries among Traditional Chinese Opera Actors are highly prevalent and widespread, with an extremely high incidence rate. The injury rates were similar between males and females, with no significant gender differences observed. In terms of injury frequency, 1–3 injuries are the most common, although multiple injuries are also observed, indicating that some actors experience recurrent injuries. In terms of injury types, chronic injuries predominate and some arise from prolonged acute injuries, indicating that improper management of acute injuries can easily lead to chronic conditions. In terms of injury sites, the majority of cases were concentrated in the lumbar region, back, ankles, and knees,

accounting for a combined proportion of 57.95%. Other anatomical regions also exhibited injuries, but with significantly lower incidence rates. Among various performance movements, jumps and flips are most likely to cause acute injuries, followed by jumping movements. The timing of injury occurrence follows certain patterns: the incidence of injuries during daily training is significantly higher than that during stage performances; injuries are most prevalent during the middle phase of training sessions; and the intermediate stages and the final phases of individual movement execution represent peak periods for acute injuries.

3. Factors Influencing the Occurrence of Sports Injuries in Traditional Chinese Opera Actors

There are numerous factors contributing to sports injuries among Traditional Chinese Opera Actors. According to the epidemiological triangle model, the influencing variables of injury can be categorized into host factors, environmental factors, and mediating factors [5,6]. Based on this and considering the characteristics of opera performance and training, the influencing factors of injury occurrence were systematically identified (Table 1). Subsequently, consultations were conducted with industry experts in traditional Chinese opera physical performance regarding the aforementioned influencing factors, and their input was solicited. A student questionnaire encompassing 12 representative factors contributing to sports injuries among Traditional Chinese Opera Actors was ultimately developed. Using the Likert scale methodology, participants rated the impact of each factor on injury occurrence (with higher scores indicating greater significance). The survey results are shown in Table 2. The results demonstrated that the vast majority of investigated factors scored highly (4 or 5 points), indicating that participants generally considered these factors to have a significant impact on injury occurrence. Insufficient post-training

recovery, inadequate mastery of technical movements (which are often performed ineffectively or incorrectly), physical discomfort, unexpected incidents, and poor concentration are widely recognized as significant contributing factors, accounting for over 60% of cases scoring 4 or 5 points. Among these factors, technical execution issues accounted for the highest proportion of 5 points (42.11%) and were widely recognized as the primary cause; insufficient post-training recovery combined with scores of 4 and 5 points represented the highest percentage (70.42%), indicating severe neglect of the recovery phase; physical discomfort (e.g., fatigue, sports injuries) constituted the most prevalent factor with a score of 4 points (38.39%) and also served as a critical contributing factor. The score distributions for "poor mood" and "weather, venue, equipment, clothing, and prop-related factors" are either relatively scattered or concentrated at 3 points, indicating low perceived importance.

Analysis of the above results indicates that the primary causes of injury are attributable to host-related factors, particularly technical compliance, physical function and fatigue recovery, warm-up routines, attention levels, and training load. "Insufficient post-training recovery" and "inadequate/incorrect technical execution" are the two most recognized key factors, indicating that interventions should prioritize addressing these aspects. Accidental incidents cannot be overlooked, and safety anticipation and protective measures during training must be strengthened. In conclusion, the prevention of sports injuries among Traditional Chinese Opera Actors should focus primarily on standardized technical instruction, mandatory post-training recovery protocols, thorough warm-up routines, attention training, load monitoring, and physical function management, while also incorporating comprehensive accident prevention and protective measures.

Table 1. Factors Influencing the Occurrence of Sports Injuries among Traditional Chinese Opera Actors

Category	Category	Content
host factors	technical factors	The technical characteristics of the performed movements, proficiency level, difficulty and complexity, as well as the physical requirements associated with these movements.
	physiologic factor	gender, age, physical fitness level, degree of physical fatigue, etc.
	category factors	main characters, types of training sessions, performance genres, etc.

	training factors	training duration, training content and methods, training load, post-training recovery, pre-class warm-up, post-class relaxation, self-protection awareness, etc.
	cognitive factors	level of understanding regarding technical principles, training principles, sports injuries, and treatment and rehabilitation
environmental factors	natural causes	season, temperature, humidity, etc.
	cultural environment	instructor's guidance level, classroom atmosphere, and peer support and collaboration, etc.
mediating factors	site factors	hardness, light, space, etc.
	equipment factors	equipment, training shoes, training uniforms, etc.

Table 2. Investigation Results on the Impact Degree of Various Factors on the Occurrence of Sports Injuries

Factors contributing to sports injuries	Level of Importance				
	1point	2point	3point	4point	5point
physical discomfort	4.46%	13.39%	13.39%	38.39%	30.37%
poor physical fitness	13.06%	10.21%	24.82%	27.74%	24.17%
The technical movements are not mastered, proficient, or correct.	14.04%	7.02%	9.65%	27.18%	42.11%
impaired concentration	12.17%	10.66%	17.21%	28.99%	30.97%
bad mood	27.18%	17.82%	16.55%	21.18%	17.27%
poor self-protection awareness	14.80%	16.00%	19.20%	28.80%	21.20%
insufficient warm-up activities	15.55%	8.87%	21.77%	21.77%	32.04%
insufficient recovery after training	10.03%	8.02%	11.53%	31.19%	39.23%
excessive training load	17.76%	9.93%	15.11%	29.80%	27.40%
inappropriate protective measures	20.48%	10.61%	18.18%	28.03%	22.70%
factors related to weather, venue, equipment, clothing, and props	17.69%	19.12%	27.21%	22.74%	13.24%
accidents and emergencies	9.82%	11.61%	16.96%	33.04%	28.57%

4. Prevention Strategies for Sports Injuries in Traditional Chinese Opera Actors

4.1 Current Management Practices for Sports Injury Management

Timely and effective management and treatment are crucial once sports injury occurs. The current response measures following the injury were investigated. Statistical analysis revealed that after sustaining an injury or experiencing pain, the majority of Traditional Chinese Opera Actors only "occasionally" communicate (59.6%) with their instructors or physicians; a subset "never" communicate (30.18%), while very few do so "every time" (10.22%). This indicates inadequate post-injury communication, coupled with a lack of timely feedback and professional guidance, which may readily lead to delayed treatment or exacerbation of the injury. Furthermore, the treatment options for sports injuries remain relatively limited, predominantly involving physical therapies such as cryotherapy, thermotherapy, electrotherapy (37.11%), and

ultrasonography (30.85%), as well as pharmacological treatments and traction therapy (20.67%), while sports rehabilitations often neglected. The adoption of exercise therapy (rehabilitative training) remains very low (10.06%). This indicates insufficient emphasis on active rehabilitation and functional recovery, which is detrimental to the management of chronic injuries and prevention of recurrence. It is precisely these therapeutic interventions that result in suboptimal recovery and recurrence rates following injury: incomplete post-injury rehabilitation leads to persistent or recurrent injuries; the absence of systematic physical assessment prior to returning to training increases the risk of secondary injuries or chronic conditions.

4.2 Future Prevention Strategies for Sports Injuries

Based on the results of epidemiological investigations and current practices in post-injury management, the following preventive strategies are proposed.

4.2.1 Establish a comprehensive system for the prevention and control of sports injuries among Traditional Chinese Opera Actors

The current opera education system lacks instruction in sports human science disciplines (such as exercise anatomy, sports biomechanics, exercise physiology, and sports training), as well as fundamental theories of sports injuries and rehabilitation. This results in both educators and learners being unable to scientifically understand and apply the principles governing human movement, let alone grasp the underlying mechanisms of physical activity or effectively prevent and treat injuries. Given this, it is essential to foster interdisciplinary collaboration between the study of traditional Chinese opera performance and fields such as sports science, sports medicine, and artificial intelligence. Specific compulsory courses should be established, covering topics including sports anatomy, injury mechanisms, early injury detection, first aid management, and rehabilitation training. When designing training courses for traditional Chinese opera professionals, relevant knowledge on the treatment and prevention of sports injuries should be incorporated. Specifically, it is highly recommended to include information about the Functional Movement Screening (FMS) movement quality assessment system in these courses, enabling opera instructors to independently utilize this assessment tool to evaluate the risk of sports injuries among traditional Chinese opera performers. Furthermore, by fostering collaboration among professionals from diverse disciplines such as sports, traditional Chinese opera, and medicine, we can fully leverage the advantages of interdisciplinary research to develop a set of guidelines for injury prevention and rehabilitation tailored to the characteristics of sports injuries among China's traditional opera performers. Additionally, this approach aims to establish standardized protocols for pre-training warm-ups, post-training recovery, and tiered management strategies for individuals with varying degrees of injury severity.

4.2.2 Provide Chinese opera performers with additional learning opportunities in the field of human movement science

The improvement in the performance skills of Chinese opera actors is largely influenced by their instructors; similarly, their theoretical understanding of sports injury-related

knowledge and practical abilities in preventing such injuries are also shaped by their instructors [7].

In essence, traditional Chinese opera performance is a process of transforming both the physical and psychological capacities of performers. During this process, actors must first endure stimuli of considerable intensity, prompting their bodies to undergo various physiological and psychological adaptations. Throughout this process, opera performers are assigned distinct emotional expressions tailored to their respective roles [8]. Therefore, accurately mastering the fundamental principles of human movement during performance and applying these principles appropriately in physical training are the essential prerequisites for scientifically guiding and effectively preventing sports injuries among traditional Chinese opera performers. Influenced by historical factors related to the study of traditional Chinese opera, most teaching practices rely primarily on experiential learning through oral instruction and hands-on demonstration. This approach is heavily shaped by teachers' subjective perspectives, while there remains limited understanding of how to employ scientific training methods to systematically guide students in mastering relevant skills. Therefore, it is essential to provide training opportunities in human movement science for teachers specializing in traditional Chinese opera. When designing the relevant knowledge components for training, the following topics may be considered: biomechanical analysis of body movements, risk assessment of sports injuries, methods for monitoring exercise load and fatigue, post-training physical and mental recovery strategies, as well as treatment and rehabilitation measures for sports injuries.

4.2.3 Emphasize physical and mental recovery during training

Without proper post-training recovery, there can be no significant progress—this is a fundamental principle in sports science, and it applies equally to the physical training of traditional Chinese Traditional Chinese Opera Actors [9]. "Inadequate post-training recovery" is a common issue in contemporary physical training for traditional Chinese opera. The primary reasons lie in insufficient awareness of the importance of physical and mental recovery, as well as a lack of understanding of the corresponding measures and practical requirements. In this regard, on one

hand, the subjective awareness should be enhanced through the sports science training mentioned above; on the other hand, mandatory stretching, relaxation, and recovery exercises must be performed after each actual training session to promote active physical recovery. When conditions permit, alternative rehabilitation measures such as alternating hot and cold baths, massage therapy, or physical rehabilitation equipment may also be administered.

4.2.4 Develop exemplary technical models to compare conventional teaching methods with differentiated instruction approaches

The greater the difficulty of a movement, the higher the associated risk during learning and practice [10]. Therefore, for high-difficulty movements, technical action standards and a step-by-step teaching system should be established, emphasizing the biomechanical rationality of the movements. It is recommended to utilize motion capture systems in teaching and training to collect kinematic data of high-difficulty performance movements, and employ artificial intelligence technologies to develop action technical models. During training, actual techniques are compared with technical models using methods such as video feedback to identify gaps and propose improvement strategies, thereby achieving scientifically grounded training of movement techniques. Additionally, tiered and grouped training can be implemented based on the practitioner's physical fitness, technical proficiency, and performance requirements. For individuals with inadequate physical fitness or technical foundation, high-difficulty compound movements should be learned selectively or progressively.

4.2.5 Promote the rehabilitation concept of exercise therapy and emphasize returning to training only after evaluating physical conditions

There are numerous treatment and rehabilitation approaches for sports injuries. According to the current investigation results, most traditional Chinese opera performers tend to prioritize passive treatment modalities such as cold/heat therapy, electrotherapy, and pharmacotherapy when suffering from sports injuries, while rarely opting for exercise therapy aimed at promoting functional recovery. It is precisely due to a lack of understanding of exercise therapy and neglect of its application in injury treatment that some traditional Chinese opera performers often experience delayed healing, recurrent symptoms,

and an increased proportion of chronic cases following sports injuries. Therefore, it is essential to systematically promote the concepts and practical methods of sports rehabilitation. Specific measures include: developing staged rehabilitation plans for the acute phase, recovery phase, and reintegration phase based on injury type and severity, thereby establishing a hierarchical rehabilitation system; designing standardized rehabilitation protocols for common injuries—such as Swiss ball core training, resistance exercises with resistance bands, eccentric training, and balance board training—and promoting these exercise-based therapeutic approaches; after injury treatment, conducting functional movement screening, pain visual analogue scoring, and specialized movement simulation tests to determine whether patients are eligible for returning to regular training based on assessment results.

4.2.6 Provide psychological support for the physical training of traditional Chinese opera performers, with particular emphasis on guidance in attention training

The survey identifies "lack of concentration" as a significant injury-contributing factor, and although "poor emotional state" received a relatively low rating among the risk factors, it may still indirectly affect judgment and reaction capability during high-risk maneuvers. Furthermore, in interviews with industry practitioners, it was revealed that psychological aspects have received virtually no attention. Therefore, in daily training, it is essential to enhance psychological support during the training process of traditional Chinese opera performers and emphasize the specialized application of specific attention-training techniques, thereby improving the conventional prevention system for sports injuries. These measures may specifically include providing psychological counseling after sports injuries, incorporating mindfulness-based mental training during workouts, scientifically applying attention-guided training techniques, and encouraging positive communication and feedback throughout the training process.

5. Conclusion

This study conducted an epidemiological investigation into sports injuries among traditional Chinese opera actors, revealing a significant prevalence of such injuries with an overall incidence rate as high as 92.57%.

Chronic injuries accounted for a higher proportion than acute injuries, and some chronic injuries originated from acute injuries. The lumbar region, ankle joint, and knee joint are the anatomical areas most susceptible to sports injuries in traditional Chinese opera actors. Traditional Chinese opera actors are most susceptible to acute injuries when performing jumping or flipping movements, and the incidence of sports-related injuries is particularly higher at the moment just before the completion of these actions. Sports injuries are more likely to occur during daily training than during stage performances, with the middle phase of training sessions being more prone to injury than the initial and concluding phases. Finally, to better prevent sports injuries among traditional Chinese opera performers, this study proposes several strategic scientific prevention recommendations from multiple dimensions, including the establishment of a comprehensive sports injury prevention system, professional training for instructors, physical and mental recovery after exercise, digital teaching methods, post-injury rehabilitation therapy, and enhanced psychological training.

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