

# Correlation and influencing factors between technical scores and overall performance in Chinese wushu duanbing competitions

Pei-Zhang Yi<sup>1A-D</sup>, Jin-Yong Feng<sup>1B,D</sup>, Wei-Lei Yang<sup>2B,C</sup>, Lian-Zhen Ma<sup>1A,D</sup>, Hai-Dong Chen<sup>1\*,A-E</sup>

## Authors' Contribution:

- A Study Design
- B Data Collection
- C Statistical Analysis
- D Manuscript Preparation

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## Dictionary:

**Duanbing** – is a modern evolution of traditional Chinese hand-to-hand fight. It uses safety-enhanced equipment to allow athletes to compete while applying short weapon techniques. The goal is to preserve and develop these skills while promoting fitness. The two main competition formats are the 'single-strikes system' and the 'continuous-strikes system', with the latter being more widely used. The debate over which rule set is superior continues [36, 37].

**Intelligent Scoring Systems** – this system integrates electronic sensors into duanbing protective gear and equipment, enabling automatic scoring based on impact strikes or thrusts detected through pressure sensors. Currently, the primary scoring areas in duanbing competitions include the head, forearms, torso, and lower legs [38, 39].

<sup>1</sup> South China Normal University, School of Physical Education and Sports Science, No. 378, Waihuan West Road, Panyu District, Guangzhou City, Guangdong Province, China;

<sup>2</sup> Guangdong Polytechnic Normal University, School of Physical Education and Health, Tianhe, Guangzhou, China;

\*Corresponding author: Hai-Dong Chen; School of Physical Education and Sports Science, South China Normal University, No. 378, Waihuan West Road, Panyu District, Guangzhou City, Guangdong Province, China; E-mail: 2968241505@qq.com

## Abstract:

**Background and Study Aim:** *Duanbing*, a key practice in modernizing traditional Chinese hand-to-hand fight, faces challenges in technical evaluation and training feedback, with ongoing debates over the rules. Existing studies lack a systematic analysis of its technical performance and competition outcomes. The cognitive goal of this work is the factors significantly influencing the so-called technical efficiency of motor actions during hand-to-hand combat based on the criteria of the duanbing system. The application goal is recommendations for *duanbing's* sustainable development.

**Material and Methods:** Using a mixed-method approach, quantitative analysis of 109 match videos from the men's events at the 9th World Kungfu Championships identified significant technical movements impacting scores. A grounded theory approach revealed 13 influencing factors across six dimensions, including rules, techniques, training, competition, systems, and development suggestions, based on interviews with 20 athletes and coaches.

**Results:** The correlation analysis shows that head, forearm, and torso strikes are significantly related to total scores ( $p < 0.01$ ), with head strikes having the most substantial impact ( $r = 0.76$ ). Multiple regression confirms their positive effects, explaining 94.4% of score variation. Combination analysis reveals that while individual actions enhance performance, the interaction of head and forearm strikes slightly reduces total scores ( $p = 0.05$ ). These findings provide data-driven insights for optimizing *duanbing's* training and competition strategies.

**Conclusions:** The current rules emphasize continuous striking, limiting tactical diversity. This study recommends balancing single-strike and combination techniques through optimized rules, refined training, and integration of traditional *wushu* culture to enhance technical diversity, preserve heritage, and improve competition quality for *duanbing's* sustainable development.

**Keywords:** innovative agonology, technical performance; techniques;

## 1. Introduction

**Technique** – *noun* a way of performing an action [40].

**Tactics** – *plural noun* the art of finding and implementing means to achieve immediate or short-term aims [40].

**Performance** – *noun* the level at which a player or athlete is carrying out their activity, either in relation to others or in relation to personal goals or standards [40].

**Defence** (in the language of agonology) – Tadeusz Kotarbiński, the creator of the (agonology), lists a counter-attack as a basic way of defence. He pays attention onto a seeming paradoxically of a statement: ‘(...) that any defence is a certain form of attack and only the reciprocal is not a truth not any attack is a defence’ [41, p. 130].

**Defensive action** (in fencing) – is the appropriate movement of the armed arm with weapon with intent to prevent the attack of opponent [42].

**Ippon** – one point. Achieved through the execution of a valid technique on the opponent [43].

**VR (virtual reality)** and **AR (augmented reality)** – are two technologies that are changing the way we use screens, creating new and exciting interactive experiences.

As an integral component of traditional Chinese sports, *wushu* carries a profound cultural significance and continues to evolve in modern society, generating various social functions and values [1]. Since ancient times, *wushu* has served not only as a skill for warfare and self-defence but also as a means of self-cultivation [2]. *Wushu* emphasizes cultivating the body and mind, seeking harmony between them, making it a sport and a reflection of human spiritual pursuits and life attitudes.

Duanbing, as an essential branch of *wushu's* development, holds unique historical and cultural significance and has evolved from ancient fencing techniques [3]. In 1928, *duanbing* began its formal promotion and was included as a national *wushu* competition event in 1933, undergoing a series of adjustments and experiments regarding its rules and forms [4]. However, despite flourishing in the People's Republic of China's early years, *duanbing* experienced a period of stagnation. It was not until recent years, under the advocacy of individuals such as Mr. Ma Mingda, that *duanbing* experienced a resurgence in Guangzhou, gradually spreading across the country and becoming an essential event in *wushu* competitions [5].

In 2020, the International Olympic Committee officially confirmed that breaking would be included as a competitive event in the 2024 Paris Olympics. Additionally, Chinese dragon boat racing will make a spectacular appearance at the opening ceremony of the 2024 Paris Olympics, providing invaluable experience and insights into the modernization of traditional Chinese sports. These cases demonstrate that traditional Chinese sports are revitalizing and showcasing their unique charm on the global sports stage by building on classical traditions and continuously innovating.

To promote the modernization of traditional Chinese sports and integrate them into the international sports system, relevant departments have actively supported *duanbing* competitions, organizing training and competitive events, which has led to rapid development [6]. Including *duanbing* in the 9th World Kungfu Championships marks an essential milestone in its development, pushing the sport toward internationalization and showcasing the status and influence of traditional Chinese *wushu* on the global stage [7]. The display of *duanbing* competitions at international events enriches Chinese *wushu* forms. It fosters the dissemination and exchange of Chinese culture, offering more opportunities for global *wushu* enthusiasts to learn and communicate [8].

The competitive nature of *duanbing* not only responds positively to China's sports development plans but also represents the creative transformation and innovative development of China's excellent traditional culture [9]. The technical scoring system for *duanbing* competitions has been continually refined in recent years. By incorporating intelligent scoring systems, the fairness and transparency of competitions have been improved, providing a more equitable competitive environment for athletes. Intelligent scoring systems have been widely applied in other combat events, such as karate and judo. These systems enhance the objectivity of competition results and profoundly impact athletes' technical choices [10]. At the same time, biomechanics research is increasingly applied in combat sports. Studies show that 3D motion capture and electromyography measurements can assess athletes' strength and reaction time in real-time, optimizing training methods and improving competitive performance [11]. These findings provide a scientific basis for further optimizing technical choices in *duanbing* competitions.

However, compared to traditional manual scoring systems, intelligent scoring systems pose new challenges to athletes' technical and tactical choices, training methods, and competition strategies. At present, academic research primarily focuses on *duanbing* techniques under traditional manual scoring systems, while research on the relationship between technical scores and total scores under intelligent scoring systems is still in its early stages, with a limited in-depth exploration of the development trajectory of *duanbing* competitions [12, 13].

Moreover, the correlation between athletes' technical characteristics and competition results under intelligent scoring systems reflects existing developmental issues in Chinese *wushu duanbing* competitions. The imperfect rule system is the central contradiction restricting its development. Similar challenges exist in sports like karate, where competition rules have evolved to meet the demands of modern sports events. Research has indicated that karate competitions have undergone several phases of reform since the 20th century, such as incorporating semi-contact modes into the Olympic system to enhance the sport's spectacle and fairness. These studies provide a valuable reference for developing *duanbing* competition rules [14].

The cognitive goal of this work is the factors significantly influencing the so-called technical efficiency of motor actions during hand-to-hand combat based on the criteria of the *duanbing* system. The application goal is recommendations for *duanbing*'s sustainable development.

## 2. Materials and Methods

Associating the application goal of this work with the sustainable development of *duanbing* (training and effects verified during sports competition) refers directly to the mission and the key term of innovative agonology – 'development'.

In this new relevant science [15-17] 'development' is associated exclusively with phenomena of positive significance [18, 19]. Therefore, by 'sustainable development of *duanbing*' we mean promoting the health values of this form of human psychophysical activity within the framework of a universal, supra cultural practice of hand-to-hand combat combined with concern for personal safety. We emphasize the importance of this basic assumption, because the origin of *duanbing*, although deeply rooted in the culture of Chinese *wushu*, is not a factor that would destroy the universal values of any hand-to-hand combat practice with clear references to respecting the ethical principles of competition and respect for the dignity of another human being. The reference to the patterns of the Greek 'agon' (from which the name 'agonology' derives is most appropriate [20-24].

To achieve the above research objectives, this study adopts a mixed-methods approach, combining both quantitative and qualitative research to comprehensively explore the factors influencing the development of Chinese *wushu duanbing* competitions. The quantitative research will analyse competition data from the 9th World Kungfu Championships using mathematical and statistical methods to assess the scoring potential of different technical movements, identify key technical actions influencing athletes' overall scores, and evaluate the impact of the intelligent scoring system. The qualitative research will employ grounded theory methodology, interviewing athletes and coaches to explore the factors influencing technical and total scores and analyse the developmental challenges of *duanbing* competitions in inheritance and innovation.

### *Quantitative evaluation criteria*

We used video samples from 109 men's Chinese Wushu Duanbing Competitions in the 9th World Kungfu Championships to explore the relationship between technical scores and overall performance through data collection, technical movement classification, and statistical analysis.

First, each athlete's technical movements during the competition were recorded through video analysis, and the success rate and final score were tallied. The collected data underwent pre-processing steps, such as outlier cleaning and missing data handling, to ensure the accuracy of subsequent analysis. Next, based on the tactical characteristics of *duanbing* sports and the practical application in Chinese Wushu Duanbing Competitions, the technical movements were categorized into head strikes, forearm strikes, torso strikes, leg strikes, head thrusts, torso thrusts, turning strikes,

defense other than counter-attack, counterattacks (see dictionary), and combination attacks.

Finally, Pearson correlation coefficient analysis was used to examine the relationship between the scores of each technical movement and the overall score, and multiple regression analysis was employed to explore the specific impact of each technical movement on the overall performance. Additionally, a combination effect analysis was conducted to investigate the influence of different combinations of technical movements on the athletes' overall score. The research hypothesis posits a significant correlation between specific technical movements and the overall score and that combining technical movements may uniquely impact the overall score. SPSS statistical software was used for data analysis.

#### *Qualitative evaluation criteria*

We considered qualitative research as the basis interviews with athletes and coaches to deeply explore the factors influencing technical scores and overall performance and the developmental issues of Chinese Wushu Duanbing Competitions in inheritance and innovation. A theoretical sampling method was used to select 20 athletes and coaches from several university *duanbing* teams as interview subjects, ensuring the sample's typicality, representativeness, and diversity. The interview guide was designed around the research objectives and covered background information, rules, techniques, training, competition, competition systems, and development. The interviews were recorded using voice transcription software. Data analysis involved coding, extracting themes, and qualitative analysis using Nvivo (Leading Qualitative Data Analysis Software) and organizing and classifying data with Excel and other spreadsheet tools.

Using a mixed-methods research approach we analysed the factors influencing the development of Chinese Wushu Duanbing Competitions from multiple dimensions, prioritizing the resolution of primary conflicts and addressing secondary ones. This approach provides a more comprehensive and in-depth theoretical guidance and practical references for improving and developing Chinese Wushu Duanbing Competitions projects.

#### *Selective coding method*

Selective coding aims to organize the relationships between categories, pinpoint the core category, and establish connections with other categories. This study identifies Chinese Wushu Duanbing Competitions as the core category, systematically analysing the relationship between individual development and social capital in the development of Chinese Wushu Duanbing Competitions. We base ourselves on Robert D. Putnam's social capital theory [25]. This theory focuses on the connection between social capital and civil society, emphasizing the importance of social relationships, networks, norms, and trust in society. It posits that social capital is the foundation of social cohesion, facilitating civic participation and social cooperation.

The specificity of this research requires two deviations from the form of the 'Results' section in the original paper. First, some important details of the methods used are explained in this section instead of in 'Material and Methods'. Second, some detailed conclusions that are related to training practice.

### **3. Results**

#### *Correlation analysis between technical scores and overall scores*

The correlation analysis between technical and overall scores reveals that several technical movements significantly correlate with the athletes' overall performance. Specifically, head strikes, forearm strikes, torso strikes, and combination attacks show a significant positive correlation with overall scores, with correlation coefficients of 0.76, 0.41, 0.44, and 0.37, respectively, and corresponding p-values all less than

0.01, indicating a strong relationship between the scores of these technical movements and the overall score. Turning strikes also demonstrates a significant positive correlation with the overall score, with a correlation coefficient of 0.20 and a p-value of 0.02. However, the correlation between leg strikes, head thrusts, torso thrusts, defense and counterattacks with overall scores is insignificant, indicating a weaker relationship between the scores of these technical movements and the overall score (Table 1).

**Table 1.** Correlation technical scores (associated with a motor action with a part of the body or with an expressive aspect, either offensive or defensive) and overall scores.

Variable (X)	Mean & SD	r	p
head strikes	12.06 ±7.66	<b>0.76</b>	<0.01
forearm strikes	5.98 ±4.57	<b>0.41</b>	<0.01
torso strikes	6.02 ±5.54	<b>0.44</b>	<0.01
leg strikes	0.28 ±0.71	0.14	0.11
head thrusts	0.18 ±0.62	-0.02	0.86
torso thrusts	0.18 ±0.70	0.08	0.35
turning strikes	1.73 ±3.44	<b>0.20</b>	<0.02
defense other than counter-attack	10.55 ±10.69	0.09	0.28
counterattack	1.99 ±3.95	0.09	0.30
combination attack	3.97 ±4.89	<b>0.37</b>	<0.01
Indicator Y (mean ±)	26.27 ±11.18		

#### *Regression analysis between technical scores and total scores*

The regression analysis results indicate that the model is highly significant in predicting the athletes' overall scores, with an F-value of 218.13 and an adjusted R-square value of 0.944. This suggests that the model can explain 94.4% of the variability in the overall scores.

The regression coefficients for head strikes, forearm strikes, and torso strikes are 1.05, 1.02, and 0.87, respectively, with standardized Beta coefficients of 0.72, 0.42, and 0.43. These results indicate that these technical movements significantly positively impact overall scores, with head strikes having the most notable effect. Leg strikes and turning strikes also positively influence overall scores, but their impact is relatively minor. However, the effects of head thrusts, torso thrusts, defense, counterattacks, and combination attacks are insignificant, indicating that these technical movements have a less direct impact on overall scores within the model.

In summary, head strikes, forearm strikes, and torso strikes are the key technical movements that significantly influence the athletes' overall scores. These findings provide tactical guidance for coaches and athletes, helping them focus more on these technical movements during training and competitions to improve their performance (Table 2).

**Table 2.** Regression analysis

Scoring technique	B	Standardized Coefficient Beta	t	p	F	Adjusted R-squared
head strikes	1.05	0.72	33.15	<0.01	218.13	0.94
forearm strikes	1.02	0.42	18.93	<0.01		
torso strikes	0.87	0.43	18.44	<0.01		
leg strikes	1.9	0.12	5.3	<0.01		
head thrusts	-0.13	-0.01	-0.27	0.79		
torso thrusts	0.23	0.01	0.6	0.55		
turning strikes	0.25	0.08	3.32	<0.01		
defense other than counter-attack	-0.03	-0.03	-0.79	0.43		
counterattack	-0.01	-0.003	-0.08	0.94		
combination attack	0.05	0.02	1	0.32		

**B** unstandardized coefficient, **t** t-statistic, **F** F-statistic.

*Analysis of the impact of strongly correlated technical scores and their combinations on overall scores*

Building on the previous analysis of the combination effects of head strikes, forearm strikes, and torso strikes, the following section details the interaction effects of these technical movements and their impact on the overall scores of the athletes: the combination effect analysis results show that the multiple regression model's overall significance is very high, with an F-value of 269.38 and an adjusted R-square value of 0.93. This indicates that the model can explain 92.6% of the variability in the overall scores, demonstrating that the model effectively captures the relationship between technical scores and overall scores.

Main effects: the regression coefficient for head strikes is 1.13, with a standardized Beta coefficient of 0.07, a t-value of 16.89, and a  $p < 0.01$ , indicating a significant positive impact on overall scores. The regression coefficient for forearm strikes is 1.29, with a standardized Beta coefficient of 0.12, a t-value of 10.66, and a  $p < 0.01$ , also indicating a significant positive impact on overall scores. The regression coefficient for torso strikes is 1.07, with a standardized Beta coefficient of 0.13, a t-value of 8.23, and a  $p < 0.01$ , indicating a significant positive impact on overall scores.

Interaction effects: the interaction term for head strikes - forearm has a regression coefficient of -0.01, a standardized Beta coefficient of 0.01, a t-value of -2.01, and a  $p < 0.05$ , suggesting a slight negative impact on overall scores, though the effect is minimal. The interaction term for head strikes - torso strikes has a regression coefficient of 0.002, a standardized Beta coefficient of 0.01, a t-value of 0.22, and a  $p < 0.83$ , indicating that the combination effect on overall scores is insignificant. The interaction term for forearm strikes - torso strikes has a regression coefficient of -0.03, a standardized Beta coefficient of 0.02, a t-value of -1.51, and a  $p < 0.13$ , suggesting that the combination effect on overall scores is also not significant.

The analysis of combination effects shows that individual technical movements (head strikes, forearm strikes, and torso strikes) significantly impact overall scores. However, when considering interaction effects, it is found that the combination of head strikes and forearm strikes slightly negatively impacts overall scores. In contrast, the effects of other technical combinations are not significant. This may

indicate that, under certain conditions, specific combinations of technical movements can have varying degrees of impact on an athlete's performance. Based on these findings, coaches and athletes may need to adjust their training and competition strategies to optimize the selection and combination of technical movements, thereby improving competition performance (Table 3).

**Table 3.** Analysis of the impact of strong correlation.

Scoring technique	B	Standardized coefficient beta	t	p	F	Adjusted R-squared
head strikes	1.13	0.07	16.89	<0.01		
forearm strikes	1.29	0.12	10.66	<0.01		
torso strikes	1.07	0.13	8.23	<0.01		
head strikes *forearm strikes	-0.01	0.01	-2.01	0.05	269.38	0.93
head strikes *torso strikes	0.002	0.01	0.22	0.83		
forearm strikes *torso strikes	-0.03	0.02	-1.51	0.13		

**B** unstandardized coefficient, **t** t-statistic, **F** F-statistic

#### *Digital and emotional resonance in technical performance (detailed conclusions)*

From the quantitative research discussed above, it is clear that in the current Chinese Wushu Duanbing Competitions, the relationship between technical movements and performance indicates a higher correlation between striking the head, torso, and arms than striking the legs. Strongly correlated combination techniques have a lower impact on competition results; by combining these quantitative data with interview data (Table 4), the following conclusions were drawn regarding the underlying reasons.

First, the correlation between thrusting and striking movements is lower due to several factors: (1) thrusting movements require athletes to be fast, accurate, and fierce, which carries a high risk; it can easily give the opponent a scoring opportunity if not executed accurately; (2) the smaller contact area of thrusts increases the risk of non-scoring hits, especially with the electronic scoring equipment. Consequently, thrusts should be employed as surprise tactics rather than being the primary focus of a competitor's strategy.

Second, opponents' distance in Chinese Wushu Duanbing Competitions is close. Competitions, and most scoring points are concentrated on the upper body. Therefore, athletes focus more on upper-body strikes, often neglecting lower-body strikes. As a result, scoring with leg strikes reflects the athlete's agility and reaction speed, emphasizing *wushu's* 'quick and cunning' aspects.

Finally, from the analysis of strongly correlated combination techniques and the regression analysis of blocking, counterattacking, and combination attacks, it was found that athletes' overall use of 'dynamically linked' movements had an insignificant or even negative impact on the total score. Excluding the potential issues with the electronic protective equipment, the low significance lies in the athletes' flexible application of techniques. Interviews revealed that respondents recognized the importance of variable techniques in training and flexible responses during

competitions. However, athletes' training is primarily focused on improving competition results. Given that close-combat competitions are conducted under a 'combo system' athletes may inevitably exhibit more aggressive 'blindness' and technical 'rigidity' in actual combat. This can even lead to incidents resembling a 'whack-a-mole' game. Ultimately, the problem lies in the mismatch between athletes' training and actual combat. The rigid training system and short-term intensive training to achieve competitive results lead to immature technical practice and 'shortcut tactics' in actual combat (taking into account non-sport confrontations identified with necessary self-defence).

In conclusion, the current competition rules constrain the development of athletes' techniques and the correlation between their techniques and performance. The imperfections of the current competition rules have led to the 'simplification' and 'blindness' of athletes' competition techniques, which is detrimental to the development of traditional Chinese *wushu*. This is a question worthy of deep consideration.

**Table 4.** Coding data from *wushu duanbing* technique interviews.

Category	Conceptualization	Raw sentences
Training methods	Training versatility	I pay attention to the proficiency of techniques and the variability of tactics during training, ensuring that athletes can adapt to different competition environments.
	Combination of physical and technical training	I pay more attention to a person's sense of distance and speed — the speed of swinging the stick and the speed of blocking. So, during my training, I always have my team members perform a 30-second air strike exercise without oxygen, using the fastest speed to block and hit.
	Mental training	I emphasize the cultivation of psychological strength, performance under pressure during training, and techniques' accuracy and reaction speed.
	Speed and precision	My training focuses on speed and accuracy, which helps to improve reaction time and accuracy during matches.
Application of training methods	For practical service	Nowadays, basic training is based on anaerobic training, and all training methods must serve the technical needs of the competition, whether continuous strikes, distance strikes, or turning strikes, all of which are trained.
		Good physical training helps me maintain efficient performance for a long time in competitions, while technical training enables me to execute tactics accurately.
		Our training method emphasizes practical exercises, allowing athletes to apply the techniques learned during training in real competitions. Naturally.

Technique selection	Athlete advantage	The selection of technical movements is based on a deep understanding of the athlete's personality and strengths, combined with specific requirements for technical scores according to the competition rules.
	Practical experience	When choosing technical movements, I will determine which techniques are most effective based on my practical experience while considering the athlete's personal preferences and skill strengths.
	Opponent weaknesses	I choose technical moves and optimize our scoring strategy based on our opponents' weaknesses and our team's strengths.
Factors affecting technique selection	Athlete ability	My choice of technical movements is constrained by the athlete's ability, opponent analysis, and competition rules, and we often need to find the best balance between these factors.
	Competition rules	Through extensive practical experience, summarize some technical movements suitable for oneself or students; rules will also influence it.
	Training experience	Training experience and technological tools such as motion capture systems significantly impact my technical choices, as these tools help us optimize technical movements and tactical arrangements.
	Competition environment	My technical choices are influenced by detailed strategy planning, opponent analysis before the competition, and the actual climate conditions and competition location.
	Coach influence	Our team's tactical arrangements and coach guidance largely influence the choice of technical movements.
	Video review	The competition rules mainly influenced my technical choices, the coach's advice, and a retrospective analysis of past matches.

#### *Factors influencing the development of Chinese Wushu Duanbing Competitions*

Open coding involves conceptualizing and categorizing the statements from the original data. The interview in this study covered six sections: rules, techniques, training, competition, competition systems, and suggestions for developing competitions. After filtering the interview records, 142 original statements were identified. Contradictory initial concepts were removed, and only those that appeared more than three times were categorized, indicating saturation and the need for refinement. Nine categories were ultimately identified by excluding the technical interview sections mentioned in the previous chapter (Table 5).

**Table 5.** Open encoding.

Category	Conceptualization	Raw sentences
Training methods	Physical training; technical training	We value repeated practice and speed training of technical movements to ensure that athletes can execute them quickly, accurately, and ruthlessly under pressure.
Technical performance	Core technology application	I focus on improving my physical fitness during training, which is very helpful for increasing my movement speed and enabling me to maintain efficient performance for a more extended period in competitions.
Psychological state	Stress resistance ability	The diversity of technology and the flexible application of tactics are the key to our success in the competition.
Rules perfection	The mismatch between rules and technology	The rules of the Chinese Wushu Duanbing Competitions have significantly influenced my technical choices and competition strategies. This is mainly because the electronic scoring system leans more towards showcasing physical fitness and speed, resulting in the details of technical movements sometimes being overlooked.
Referee ability	Speciality; fairness	Enhancing referees' professionalism and match fairness are areas that need improvement. Currently, coaches from many teams serve as referees, which is not conducive to competitive sports' fairness, impartiality, and openness.
Competition organization	International exchange	I suggest that organizers consider introducing more international exchange events, which can help enhance the competition's global influence.
Intelligent, protective equipment	Protection: sensitivity of protective equipment	The main problems with the Chinese Wushu Duanbing competition system include inconsistent sensitivity of intelligence and protective equipment and defects in the design of some protective equipment, which affect the fairness of the competition and the accurate evaluation of technology.
		Insufficient protective equipment, with most athletes suffering from injuries from impacts on their elbows, knees, armpits, upper arms, thighs, and other areas during actual combat or competition
Team Influence	Team support; strategic deployment	The competition's success also depends on pre-competition preparation, the players' mentality, and the team's support, all of which are essential factors that affect the final results.
		My choice of technical movements is based on a deep understanding of the game rules and the coaching team's strategic deployment.
Cultural context	The application of traditional sports culture and technology; deep cultural integration	The rules have already positively promoted technological diversity, but further adjustments are needed to better showcase <i>wushu's</i> cultural depth.
		Although the current rules have promoted the popularization of competitions to some extent, they have not yet effectively integrated the deep values of <i>wushu</i> culture, and their role in the inheritance of <i>wushu</i> is not significant enough.

Venue environment	There are few competition venues available	Referee, protective equipment, audience, and field
Improvement suggestions	Technical improvement; diverse communication;	Strengthening international exchanges and cooperation, learning from the successful experiences of other countries in similar competitions, and promoting global sharing of technology and culture are recommended.
		Improve protective and electronic equipment, increase referee training, make minor adjustments to competition rules, encourage the use of technology, etc.
		Suggest strengthening rewards for athletes' technical and tactical innovation to stimulate more athletes' enthusiasm for participation and improve their competitive level.
Inheritance and development of <i>wushu</i>	System improvement: restore one hit system	The competition rules should restore the one-shot system and introduce the 'fatal strike' rule in a combo system, such as attacks on critical areas such as the head, throat, and heart.
		Nowadays, competitions have always been government-run, but we can encourage the private sector to hold such competitions. Competition is an exchange that drives the better development of this project. If it is just one form of <i>wushu</i> inheritance and development, it is not far from the end because it requires the support of a fundamental quantity rather than just a few people using something.
		This competition perfectly combines traditional <i>wushu</i> and modern technology, providing new living space for traditional <i>wushu</i> and broadening its international perspective.
		Although the Chinese Wushu Duanbing. Competitions are a form of modern <i>wushu</i> competition that provides a new platform, they should be more deeply integrated into <i>wushu</i> culture to achieve the goal of genuinely inheriting and developing <i>wushu</i> .

### *Axial coding*

During the axial coding phase, the categories refined from the open coding were analysed and summarized to identify the logical relationships between them and to establish the main categories. To meet the research needs of this chapter, the nine abstracted initial categories were subjectively clustered, temporarily setting aside the initial codes 'Improvement suggestions' and 'Inheritance and Development of Wushu'. Three main categories were eventually identified: individual ability, institutional norms, and external environment (Table 6).

**Table 6.** Coding of main axes

Main scope	Corresponding scope	Scope connotation
Individual ability	Training methods	It refers to the learning and translation of training methods undertaken by the athlete at the individual level, the use of techniques, and performance against stress during competition.
	Technical performance	
	Psychological state	
Institutional norms	Rules perfection	It refers to whether the construction of the social organization system can give athletes with skills competition security.
	Referee ability	
	Competition organization	
	Team influence	
	Cultural context	
	Venue environment	

*Selective coding*

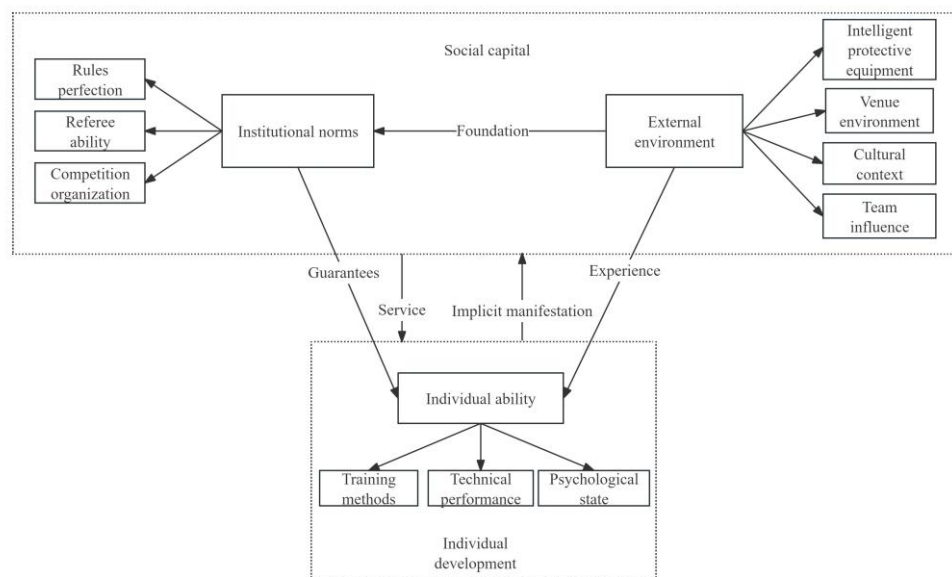
The study finds that the development of Chinese Wushu Duanbing Competitions results from the interaction between individual development and social capital (Table 7). This process aligns with Robert D. Putnam's social capital theory. It posits that social capital is the foundation of social cohesion, facilitating civic participation and social cooperation. In the development of Chinese Wushu Duanbing Competitions, individual development and social capital are interdependent: individual development forms the basis of social capital, and the social resources created by interpersonal connections lay the groundwork for development Chinese Wushu Duanbing Competitions. Social capital consistently serves individual development, providing competition conditions for athletes. The competition project's institutional construction and material foundation should align with the athletes' needs. This ensures athletes' trust and commitment to the Chinese Wushu Duanbing Competitions, promoting their development.

**Table 7.** Selective coding.

Dimension	Main scope	Associated structure	Associated connotation explanation
Individual development	Individual ability	Chinese <i>wushu</i> duanbing	Individuals are society's main body, and social ecology's construction and optimization ultimately aim to serve individuals.
	Institutional norms		Social capital Institutional norms Institutional norms are the core structure of the social ecology, and they protect individuals in competition.
Social capital	External environment	Competitions arise from the interaction between individuals and society and the empirical experience of individual ability	The external environment is the foundation of social ecology, which provides individuals with more perceptual experiences in competition.

### Model construction

This study employed a random sample of three interview transcripts to test for theoretical saturation. After undergoing the same coding process, no new categories or relationships emerged, indicating that the concepts and categories had reached saturation and the research results had high validity. Based on the three-level coding, through continuous in-depth exploration and repeated examination of each main category, the relationships between different categories were further revealed, and an attempt was made to construct a 'model influencing the development of Chinese Wushu Duanbing Competitions' (Figure 1) in a logical reasoning form.



**Figure 1.** Model construction.

Specifically, the development of Chinese Wushu Duanbing Competitions is a spiral process influenced by individual development and social capital. Personal development includes training methods, technical performance, and psychological state. In this process, training methods are the foundation of techniques, technical performance is a test of effectiveness, and psychological state is emotional regulation. It can be said that individual development is an implicit manifestation of social capital. Social capital, on the other hand, consists of two aspects: institutional norms and external environment. The external environment is the foundation of institutional norms, and both serve individual development. The institutional norms, including rules perfection, referee ability, and competition organization, provide guarantees for personal development but also have different focuses. In this competition, respondents had many disputes about refereeing ability, fairness, and rule-making. The shortcomings of these institutions can easily lead to athletes losing trust in the competition, which may cause the project to stagnate. The external environment includes four aspects: intelligence, protective equipment, team influence, cultural context, and venue environment. Intelligent, protective equipment and venue environment are the material foundation, providing athletes with scenes and equipment for an excellent physical experience; team influence and cultural context are spiritual support. Team influence encourages athletes to constantly surpass themselves and relieve psychological pressure, while cultural context allows athletes to feel the traditional sports culture through etiquette and techniques during the competition. These factors interact and transform, jointly affecting the development of Chinese Wushu Duanbing Competitions, but a factor also plays a decisive role in this development. The competition rules are the principal contradiction in the development of Chinese Wushu Duanbing Competitions. The central contradiction is

the decisive factor in the development of things. Only by grasping it can we find a breakthrough to solve the problem.

#### 4. Discussion

##### Exploring the balance between *wushu* spirit and competitive sports from technical scoring to rule reflection

The core values of Chinese *wushu* are deeply rooted in the integrated concept of 'morality, intelligence, and strength' [26]. Confucius said, 'The ways of a gentleman are three, and I am not capable of them: the benevolent are without worry, the wise are without perplexity, and the brave are without fear'. This echoes the *wushu's* pursuit of 'cultivation of martial ethics', 'application of wisdom', and 'strong physical strength'. 'Morality' refers to the cultivation of martial ethics and the concept of 'using Wushu to stop war'. Chinese *wushu* emphasizes the cultivation of martial ethics and advocates 'using wushu to stop the war', seeking to convince others with virtue [27]. *Wushu* practitioners should pursue technical excellence and pay attention to moral cultivation, using *wushu* to cultivate oneself and improve one's character rather than as a tool for aggression [28].

'Intelligence' in *wushu* is manifested in applying tactics and strategies and the ability to judge and respond to combat situations. Athletes need to adjust their tactics flexibly according to the opponent's situation and the pace of the competition to win with intelligence [29].

'Strength' in *wushu* refers not only to training physical strength but also emphasizes the cultivation of mental toughness and willpower through physical training. The various techniques and routines in *wushu* training are concrete manifestations of applying strength [30]. Therefore, the three pillars of the Chinese martial spirit are guided by martial ethics, using wisdom as a means, and based on strength [31].

From a developmental perspective, the internationalization of competitive sports is typically accompanied by the necessity for rule adjustments to optimize the competition system and enhance the global adaptability of the sport. As revealed in a study on the impact of rule adjustments by the International Judo Federation (IJF) on the results of the All Japan Judo Championships (AJJC), rule changes — particularly adjustments to the scoring system — can directly influence competition outcomes and athletes' technical choices and adaptability [32]. Research by Miyake et al. [33] indicates that after implementing the new IJF rules, the probability of winning by points in judo significantly increased. At the same time, the proportion of victories by decision correspondingly decreased. This trend mirrors the introduction of modern scoring systems in *duanbing* competitions, aimed at increasing the objectivity of the competition and ensuring greater consistency in the judging criteria. Furthermore, the study highlights that the IJF rule adjustments were designed to revive the spirit of 'ippon' in judo], which offers valuable insights for the modernization of *duanbing* competitions. It underscores how competitive elements can evolve while safeguarding the cultural core of traditional martial arts. On the other hand, studies on the techniques and tactics of kendo also provide essential references. Takami et al. [34] analysed 240 kendo matches and found no significant differences in the technical application of athletes from different countries or genders, reflecting the trend of standardization and internationalization in modern competitive hand-to-hand fight.

Similarly, the scoring systems and training methods for *duanbing* competitions should also fully consider the technical adaptability of athletes within a globalized context. Additionally, the research emphasizes the critical impact of the scoring system on tactical choices, which aligns with the core objective of the intelligent *duanbing* scoring system — namely, to enhance the fairness and transparency of the competition. Furthermore, a study on the European Wrestling Championships found that female athletes were more likely than male athletes to win through the use of illegal techniques [35], suggesting that the rules for *duanbing* competitions should be

more finely tuned across different genders and weight categories to ensure fairness in competition.

Thus, the primary contradiction is the one that plays a decisive role in developing things and is the fundamental driving force of development. The above research shows that competition rules are the principal contradiction in developing Chinese Wushu Duanbing Competitions. Therefore, this chapter uses the martial spirit framework of 'valuing virtue, pursuing wisdom, and enhancing strength' as the theoretical foundation to reflect deeply on the two competition rules of continuous strikes and single strikes, seeking a balance between *wushu* spirit and competitive sports.

The research results show that techniques such as strikes to the head, forearm, and torso have high scoring efficiency under the current rules system. However, this is not entirely due to their high-scoring potential but is related to their relative ease of execution and scoring in actual combat. This reveals the influence of the current Chinese Wushu Duanbing competition rules on the technical scoring evaluation system and the differences in technical actions at different competitive levels. However, this tendency also raises concerns about whether the emphasis on continuous strikes under the 'enhancing strength' orientation aligns with the *wushu* spirit and competitive sports principles.

Under the current rules system, continuous strikes have become a high-risk, high-reward attack strategy some athletes favour. Continuous strikes emphasize executing attack techniques quickly within a concise time frame, suppressing the opponent through multiple attacks. This aligns with the internal logic of 'enhancing strength', which aims to improve combat efficiency and effectiveness by increasing strength. However, the excessive pursuit of 'strength' can lead to the neglect of 'virtue' and 'wisdom'. For example, athletes overly focused on scoring through continuous strikes may neglect the diversity of techniques and tactics, resulting in a monotonous and less skilful competition style. Moreover, under continuous strikes, athletes prioritize offense, ignoring the importance of defensive strategies, which can expose weaknesses and increase the risk of injury, contrary to the martial virtue principle of 'stopping at the point'. More importantly, blind attacks and lack of defensive awareness under continuous strikes contradict the traditional Chinese martial philosophy of emphasizing martial morality, advocating 'stopping violence with *wushu*', and conflict with modern competitive sports principles of safety and fairness.

In contrast, single strikes better reflect the concepts of 'cultivating virtue' and 'cultivating wisdom' and can more effectively embody *wushu's* technical characteristics and cultural connotations. Single strikes require athletes to pause the attack after a successful hit and restart the engagement, encouraging proactive thinking, strategic attacks, and emphasis on the rhythm control of offense-defense transitions and defensive techniques. In single strikes, athletes need to make judgments before striking, avoid unnecessary attacks, and stop at the point after gaining an advantage, demonstrating martial morality and respect for the opponent. At the same time, single strikes focus more on tactical strategy and skill application, requiring athletes to adjust their tactics based on the opponent's condition flexibly and the competition rhythm, showcasing the martial spirit of 'strategic and courageous combat' rather than a mere contest of strength.

As a new *wushu* competitive event, Chinese Wushu Duanbing Competitions should explore innovative development paths while inheriting traditional *wushu* culture. Regarding technical and tactical development, we should not simply oppose continuous strikes and single strikes but should seek a balance in the trinity of 'Virtue, Wisdom, and Strength'.

### **Optimization path: system construction based on the integration of multi-dimensional advantages of continuous and single strikes in 'morality, intelligence, and strength'**

#### *Rule integration and innovation, balancing the advantages of continuous and single strikes*

To construct a more refined intelligent *duanbing* competition, innovation in the rule system is crucial. It is essential to avoid biases that may arise in rule design, such as overly emphasizing physical strength while neglecting technique and strategy. Therefore, the integration and innovation of rules should be prioritized, aiming to balance the advantages of continuous and single strikes. It is recommended that a mechanism combining a 'Technical Single Strike Scoring Zone' with 'Continuous Strike Suppression Bonuses' be introduced.

Specifically, a 'Technical Single Strike Scoring Zone' could be defined in key body areas, such as the head and torso vital points. Within this zone, high-quality single-strike techniques would earn higher base scores, encouraging athletes to pursue precision and control in their techniques. At the same time, in areas outside the 'Technical Single Strike Scoring Zone' or specific situations, 'Controlled Continuous Strike Suppression' should be allowed and rewarded. Continuous strikes would no longer be an indiscriminate attack but a tactical choice requiring control and strategy.

For example, the number of constant strikes could be limited, and violations during the process could be strictly penalized. This integrated mechanism allows athletes to leverage their physical advantages while simulating the real-life scenario of continuous attacks to suppress an opponent, ultimately creating a more diversified and tactically deep competition rule system. Furthermore, to maintain a fair, competitive environment, penalty mechanisms should be improved, with clear punishments for behaviours such as passive defense, time-wasting, or intentional fouls, ensuring the competitiveness and fairness of the competition.

#### *Training system innovation*

**Strengthening Tactical Strategy and Adaptability:** The training system should also undergo innovation in alignment with the integrated competition rules. The past focus on purely physical or technical training should be replaced with a comprehensive training system centred around tactical strategy. Future training should include separate 'Continuous Strike Technique Modules' and 'Single Strike Technique Modules', with specialized training for each. The former should focus on rapid initiation, continuous attack sequences, and stamina reserves, while the latter should emphasize precise strikes, predictive ability, and the ability to capitalize on opportunities. More importantly, 'Continuous Strike – Single Strike' integrated confrontational drills should be introduced to simulate real-life scenarios, enabling athletes to switch between different tactical modes and choose the appropriate strategy based on their opponent's characteristics. Tactical analysis and review sessions should be strengthened to further enhance athletes' tactical intelligence. This could be done by introducing tactical analysis courses, regularly reviewing competitions, or developing intelligent tactical analysis support systems to help athletes and coaches analyse strategies in-depth and optimize their approaches. Adaptability during competition is also crucial. Training should incorporate varied situational simulations, such as different opponent styles, varying score states, and environmental factors, along with psychological resilience training to improve athletes' ability to adapt and make decisions under pressure.

#### *Equipment innovation and cultural promotion, showcasing power and cultural charm*

The optimization of intelligent *duanbing* competitions should focus not only on enhancing the competitive aspect but also on building cultural depth. Equipment innovation serves as an essential foundation for improving the competitiveness and training value of the sport, while cultural promotion provides the soul of the

competition, enhancing its appeal. Regarding equipment, the focus should be on improving the weight and design of the *duanbing*. Specifically, it is suggested that the weight standard of the *duanbing* be adjusted to a range of 1 to 2.3 kilograms, with further refinement based on different types of *Duanbing* and competition levels. For example, training in *duanbing* could be slightly heavier than competition, and higher-level competitions could use heavier *duanbing*. Along with weight enhancement, attention should be given to optimizing the design of the *Duanbing* to reflect the cultural elegance of Chinese swords and knives while adhering to the principles of sports mechanics. This would require considering elements from ancient sword designs, such as balance point, blade curvature, and handle length.

While employing modern materials and techniques to ensure balance and control. Regarding cultural promotion, the deep exploration and innovation of expressions related to Chinese sword culture should be prioritized to increase the cultural appeal of intelligent *duanbing* competitions. Event optimization can begin with integrating Chinese sword cultural elements into logos, venue layouts, athlete uniforms, and background music, creating a culturally themed event image. Additionally, the dissemination of culture should be innovated by combining the competition with cultural performances, producing multimedia content, developing cultural products, and even using VR/AR technologies to create immersive cultural experiences, allowing more people to appreciate the charm of Chinese sword culture.

#### *Ongoing research and optimization of rule details*

The perfection of the rule system is not an immediate process but requires continuous research and iterative optimization. To ensure the rules' completeness, systematic structure, and scientific nature, multi-level rule research must be conducted, with widespread input from athletes, coaches, referees, and experts. A gradual approach should be adopted during the rule adjustment process, starting with small-scale pilot tests, such as trialling new rules in particular competitions or levels and collecting data, athlete feedback, and audience evaluations for analysis and assessment. Based on the results of these pilot tests and evaluation reports, the rules can then be iteratively optimized. A rule revision and feedback mechanism should be established, with a dedicated rule committee and a regular feedback channel to ensure that rule revisions respond promptly to practical needs while maintaining transparency and openness.

Through these multidimensional optimization paths, intelligent *duanbing* competitions are expected to undergo comprehensive improvements in rule systems, training frameworks, equipment, and cultural depth. Ultimately, they will evolve into a modern sport that is both competitive and rich in cultural charm, propelling Chinese *duanbing* sports toward a more prosperous future.

## **5. Conclusions**

Through quantitative and qualitative analysis, this study reveals the correlation between technical scores and overall performance in Chinese Wushu *Duanbing* Competitions. It delves into the existing issues within the development of these competitions. The research finds that the current rules of Chinese Wushu *Duanbing* Competitions are the primary conflict hindering their development. To promote the healthy growth of these competitions, it is recommended that a single-hit system dominate future competitions and that the competition rules be improved based on this system. For instance, the weight of scores for single consecutive hits should be reduced, while the scoring for effective single-hit techniques should be increased. Additionally, introducing 'defensive other than counter-attack scores' or 'counterattack scores' could encourage athletes to focus on defense and employ diverse techniques and tactical strategies during competitions.

Furthermore, the study results offers overall optimization suggestions from a broader developmental perspective. First, training methods should be optimized, emphasizing

technical and physical training, enhancing practical drills, introducing technology-assisted training methods, and improving trainer professionalism and coaching abilities. More importantly, it is essential to deeply explore and promote Chinese swordsmanship culture, integrate it into Chinese Wushu Duanbing Competitions, and continuously improve equipment to enhance the competition's fairness, spectacle, and safety in conjunction with modern technological advancements.

In summary, developing Chinese Wushu Duanbing Competitions requires balancing tradition and innovation. Guided by the *wushu* philosophy of integrating 'virtue, wisdom, and strength', the competition rules and evaluation systems should be refined to establish these competitions as a modern international sport that is both competitive and rich in cultural significance.

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Authors:

Pei-Zhang Yi: <https://orcid.org/0009-0009-9649-1417>

Jin-Yong Feng: <https://orcid.org/0009-0007-9829-0921>

Wei-Lei Yang: <https://orcid.org/0009-0001-0810-0423>

Lian-Zhen Ma: <https://orcid.org/0000-0002-8213-0495>

Hai-Dong Chen: <https://orcid.org/0009-0007-7251-4018>

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