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## Effect of Environmental Factors on Performance in Martial Arts Competitions

Tingxiu Zhang<sup>1\*</sup>, Lim Boon Hooi<sup>1</sup>, Lu Lu<sup>1</sup>, Yuhe Tie<sup>2</sup>

*\*Corresponding Author*

<sup>1</sup> Faculty of Education, Languages, Psychology and Music, SEGi University, Malaysia

<sup>2</sup> College of Physical Education and Arts, Shenzhen Technology University, China

tingxiu.zhang@qq.com, lboonhooi62@gmail.com, lulusmiling@sina.com, 1256667369@qq.com

Tel: +60 126103419

### Abstract

This study investigates the nexus between environmental conditions, precisely temperature and humidity, and Martial arts performance scores in Shandong, China. Analyzing data from 200 participants reveals significant impacts on athletes' Martial arts performance scores. The insights garnered empower athletes, trainers, and organizers to make informed decisions on training approaches, venue selection, and preparation strategies. Recognising the diverse effects of environmental factors, subsequent research may offer tailored recommendations for distinct martial arts disciplines. These findings contribute to developing targeted training strategies and preparation techniques, offering a roadmap to optimise martial arts performance scores in competitive settings.

Keywords: Martial arts, competition performance, environmental factors, climate.

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### 1.0 Introduction

With its rich history and cultural significance, Chinese martial arts not only holds a prominent place in traditional Chinese culture but has also garnered popularity as a competitive sport (Han et al., 2021). The performance of martial artists in competitions is influenced by a variety of factors, including individual skills, training methods, and mental preparation. However, one often overlooked aspect is the impact of environmental factors on martial artists' performance. This article will explore the influence of ecological factors on Martial arts competition performance, using the case study of Shandong Province in China. Shandong Province, located in eastern China, is famous for its vibrant Martial arts culture. With a rich heritage and a flourishing community of martial artists, Shandong has produced numerous famous masters and champion fighters (Yang, 2022). Understanding the effects of environmental factors on Martial arts competition performance in Shandong can illuminate the broader relationship between environmental conditions and Martial arts performances worldwide.

#### 1.1 Research background

Martial arts competitions demand a blend of physical prowess, mental acuity, and strategic proficiency from athletes. While discussions on Martial arts performance scores commonly centre around training, technique, and physical fitness, the influence of environmental factors on competition outcomes is frequently disregarded. The environment, including elements such as temperature and humidity, can

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have a significant impact on an athlete's performance, and these factors may vary across different regions.

### *1.2 Aim and significance of the study*

This research seeks to explore the influence of environmental factors on Martial arts performance scores within the framework of Shandong Province. The specific objectives are outlined as follows:

Firstly, ascertain and analyze the primary environmental factors impacting performance scores in martial arts competitions within Shandong Province.

Secondly, investigate variations in performance scores among martial arts athletes competing in different environmental conditions within Shandong Province.

Thirdly, explore the correlation between environmental temperature and humidity factors and martial arts performance scores.

By delving into the nuanced interplay between athletes and their surroundings, we can develop targeted strategies for training and competition. This research not only addresses a crucial gap in current discussions but also underscores the importance of incorporating environmental elements in the comprehensive evaluation of martial arts performance. Such insights can inform athletes, coaches, and organizers, enabling them to make informed decisions for training and competition management tailored to the specific environmental conditions of each region.

### *1.3 Scope of the Study*

This study focuses on Martial arts competitions among university students in Shandong Province, a prominent hub for Martial arts training and competitions in China. The investigation involves analyzing environmental factors, such as temperature and humidity, that impact martial arts performance scores in competitions. The study will analyze empirical data from recent competitions held at various locations within Shandong Province.

To achieve the research objectives, quantitative research methods will be utilized. Includes collecting and analyzing environmental data during competitions with athletes and coaches and reviewing existing literature on the relationship between ecological factors and athletic Martial arts performance scores (Oakman et al., 2020).

In conclusion, this study aims to address the research gap concerning the impact of environmental factors on Martial arts competition performance scores within the specific context of Shandong Province. The findings will contribute to the comprehension of how environmental conditions affect athlete Martial arts performance scores in Martial arts competitions, offering valuable recommendations for athletes, coaches, and sports organizations to optimize their training and competition strategies based on specific environmental factors.

## **2.0 Literature Review**

### *2.1 Environmental Factors Affecting Athletic Martial Arts Performance Scores*

Numerous environmental factors significantly influence athletic Martial arts performance scores across various sports, including Martial arts. Understanding the impact of temperature and humidity on martial arts performance scores is crucial for athletes and coaches to optimize training and competition strategies. (Menting et al., 2019). Temperature plays a pivotal role in athletic Martial arts performance scores affecting the body's thermoregulation and energy expenditure. Extreme hot or cold temperatures can impair physical abilities, leading to decreased Martial arts performance scores and an increased risk of heat exhaustion or hypothermia (Byard, 2023). Humidity levels impact the body's ability to cool down through sweating, influencing athletes' perceived exertion and hydration requirements. High humidity can impede sweat evaporation, resulting in reduced heat dissipation and potential dehydration during intense physical activity. Previous research has delved into the correlation between environmental factors and Martial arts performance. Notably, studies have scrutinized the effects of temperature and humidity on physiological responses, perceived exertion, and technical skill execution in Martial arts competitions.

### *2.2 Environmental Factors Affecting Martial Arts Performance of Shandong Athletes*

While there has been some research on the relationship between environmental factors and Martial arts performance, a notable gap remains in the literature, particularly in the context of Shandong Province. Given the province's diverse geographical features and varying climatic conditions, comprehensively examining how environmental factors impact Martial arts competition performance in this region can yield valuable insights for athletes, coaches, and competition organizers (Li et al., 2021). To bridge this existing gap, the current study aims to perform a case study in Shandong Province, scrutinizing the influence of environmental factors on Martial arts competition performance. By delving into temperature, and humidity, the research endeavors to offer a thorough understanding of how these factors shape performance outcomes in Martial arts competitions.

## **3.0 Methodology**

### *3.1 Research Design*

This study employs a case study research design to investigate the impact of environmental factors on Martial arts competition performance in Shandong Province. The case study design facilitates an in-depth examination of a specific context, allowing the exploration of the relationship between environmental factors and competition performance in the unique setting of Martial arts

competitions in Shandong Province.

### 3.2 Data Collection and Data Analysis

Data collection involves quantitative methods through questionnaires that collect students' basic information, their scores in Martial arts performance, and the environmental factors including temperature and humidity during the competition. Quantitative data will encompass Martial arts performance scores among 200 undergraduate students who majored in Physical Education at three public universities in Jinan, Shandong Province. The three public universities are typical ones in Martial arts, especially in performance scores in martial arts, encompassing both scores and rankings. It provides objective data for analyzing students' performance in martial arts and the relationships between temperature, humidity, and their scores.

Quantitative data will undergo analysis. To analyze quantitative data, descriptive statistics will be used to summarize the relationships between environmental temperature, humidity factors, and martial arts performance scores.

In summary, the research design, data collection methods, and analysis techniques used in this study aim to offer a relatively comprehensive understanding of how environmental factors impact martial arts competition performance in Shandong Province. These quantitative data findings enrich the existing body of knowledge on the subject.

## 4.0 Findings and Discussion

4.1 This study investigates the impact of environmental conditions on athletes' performance in Shandong Province, China, with a specific focus on Martial arts. Key environmental factors, including temperature and humidity, are examined to understand their influence on Martial arts performance scores. Ecology significantly influences athletes' performance across various sports, and Shandong Province, situated on the eastern coast of China, presents diverse ecological challenges that impact athletes' training and competition experiences. To offer a thorough understanding, the following section offers data analysis of environmental conditions, including average temperature and average humidity levels in different seasons in Shandong Province, delivered in Table 4-1 below:

Table 4-1: Temperature and Humidity Levels in Shandong Province

Season	Average Temperature (°C)	Average Humidity (%)
Spring	15.2	60.4
Summer	28.6	80.2
Autumn	19.8	68.9
Winter	2.7	42.5

### 4.2 Analysis of Martial Arts Performance in Varied Environmental Conditions

In the following sections, we explore the influence of environmental conditions on martial arts performance in Shandong. Utilizing performance data obtained from athletes participating in tournaments, we conducted a comprehensive statistical analysis. The results of this analysis, which emphasize the relationship between martial arts performance scores and temperature and humidity levels, are detailed in Table 4-2.

This tabulated representation aims to provide a clear visual correlation between environmental variables and Martial arts performance, offering valuable insights for understanding the nuanced impact of temperature and humidity on athletes' achievements in this specific context.

Table 4-2: Athletes' Performance Scores Concerning Temperature and Humidity

Temperature (°C)	Humidity (%)	Average Performance Score
<10	<40	8.2
10-20	40-60	8.9
20-30	60-80	7.6
>30	>80	6.9

### 4.3 Influence of Temperature and Humidity on Martial Arts Performance

With increasing temperatures, a discernible trend emerges — average performance scores tend to decline. Athletes encounter challenges in sustaining optimal performance levels, grappling with heightened fatigue, and diminished flexibility under elevated temperatures.

### 4.4 Humidity Effects

Elevated humidity levels demonstrate a detrimental effect on performance scores. Athletes contend with issues such as excessive

sweating, discomfort, and dehydration. Notably, humidity significantly influences athletes' capacity to regulate body temperature during intense physical exertion.

#### 4.5 Optimal Environmental Conditions

An optimal range for temperature and humidity conducive to peak Martial arts performance appears to be approximately 10-20°C and 40-60% humidity. Within this range, athletes are better positioned to maintain their performance at optimal levels, emphasizing the importance of environmental considerations for Martial arts practitioners.

### 5.0 Recommendations

Enhancing Adaptability in Martial Arts Tournaments: Strategies for Optimal Performance.

5.1 Competing in Martial arts tournaments within Shandong Province, akin to any athletic endeavor, necessitates adept adaptation to diverse environmental factors. Variables like temperature and humidity wield a profound influence on performance. To fortify adaptability and optimize performance, competitors are urged to integrate the following strategic training approaches.

#### 5.1.1 Acclimatization Training

Initiating acclimatization training stands pivotal. Competitors ought to progressively expose themselves to anticipated tournament environmental conditions during training. This gradual process enables the body to fine-tune physiological responses, enhancing endurance, thermoregulation, and overall performance (Liu et al., 2023). The intensity and duration of training can incrementally align with the intended tournament conditions, ensuring comprehensive preparedness.

#### 5.1.2 Hydration and Electrolyte Balance

Optimal hydration is foundational for peak performance and preventing heat-related ailments (Périard et al., 2021). Competitors must cultivate robust hydration habits, sustaining fluid intake throughout training and competitions. Vigilant monitoring of urine color serves as an indicator of proper hydration. Considering potential electrolyte loss in high-temperature environments, replenishing electrolyte balance through sports drinks or enhanced fluids becomes paramount. This safeguards fluid equilibrium, sustains muscle function, and diminishes dehydration and cramping risks.

#### 5.1.3 Cooling Strategies

Strategies to mitigate the impact of elevated temperatures and humidity can be instrumental. Employing pre-cooling techniques like cold water immersion or cooling vests before competitions effectively reduces core body temperature, positively impacting subsequent performance. In between matches, cooling methods such as cold towels, ice packs, or cooling apparel help dissipate heat, averting overheating (Bousfield, 2019). Implementing these cooling strategies contributes to increased comfort, reduced fatigue, and enhanced cognitive function during tournaments.

#### 5.1.4 Breathing Techniques

Air quality, particularly in areas with elevated pollution levels, can significantly affect athletes. (Beavan et al., 2023). Competitors should prioritize employing effective breathing techniques to enhance oxygen uptake while minimizing pollutant inhalation. Deep diaphragmatic breathing, including exercises like box breathing or pursed lip breathing, fosters optimal oxygen exchange, contributing to improved endurance despite adverse air conditions.

5.2 Coaches are instrumental in preparing competitors for Martial arts tournaments. To enhance adaptability to environmental factors and optimize performance, coaches should prioritize specific training elements.

#### 5.2.1 Environmental Simulation Training

Creating training environments replicating anticipated tournament conditions is crucial (Farley et al., 2019). This involves adjusting facilities, utilizing temperature control, or employing environmental chambers to simulate the tournament's climate. Such simulations aid athletes in developing effective strategies, ensuring mental and physical preparedness, and evaluating performance under challenging circumstances.

#### 5.2.2 Periodized Training Programs

Developing periodized training programs is vital (Wetmore et al., 2020). These programs should systematically address temperature, humidity, and altitude considerations at different training stages. Gradually increasing the intensity and duration of training allows athletes to adapt physiologically, promoting optimal performance in target environments. Coaches must meticulously plan and monitor training progressions to prevent overtraining and injury.

#### 5.2.3 Sport Science Support

Coaches should collaborate with sports scientists and medical professionals to optimize competitors' adaptation strategies (Stevens et al., 2021). These experts offer valuable insights on individualized training approaches, including nutritional considerations, hydration

protocols, and heat acclimation. Utilizing sports science support enables evidence-based decision-making, monitoring of physiological responses, and adjustments to enhance overall training and performance outcomes. This collaborative approach elevates the athletes' preparedness for the challenges posed by environmental factors in Martial arts tournaments.

#### 5.2.4 Enhancing Psychological Resilience in Athletes

Coaches are pivotal in ensuring athletes' psychological preparedness for adapting to diverse environmental factors. Competitors may encounter stress or anxiety when facing unfamiliar or challenging conditions. Therefore, coaches should employ effective strategies to foster mental resilience, emotional regulation, and focus amid varying environmental circumstances. Psychological preparation encompasses visualization techniques, positive self-talk, and stress management strategies (Reigal et al., 2020).

## 6.0 Conclusion

6.1 The scientific evaluation of Martial arts teaching is a crucial measure to drive the reform and enhance teaching quality. Presently, the evaluation mechanism in Shandong primarily centers on academic performance, comprehensively assessing movement specifications, proficiency levels, force, and movement rhythm in Martial arts routines. However, this evaluation approach, deeply influenced by competition, overlooks students' lifelong sports consciousness. Moreover, the evaluation fails to consider students' perspectives on the curriculum, necessitating the addition of indicators such as students' efforts and progress. A comprehensive evaluation mechanism would offer insights into teachers' teaching and students' learning experiences. Through a questionnaire survey, insights into Martial arts teaching in Shandong were gained. The main focus of Martial arts teaching is routine learning, posing challenges for students regarding movement numbers, directional changes, and route variations. Students invest significant time and energy in movement memory, resulting in difficulties remembering post-movement test situations. Furthermore, students encounter challenges due to the high physical demands of Martial arts learning, especially for those unfamiliar with Martial arts before university. The survey revealed a misalignment between the content of Martial arts courses, which predominantly emphasizes movement standards, work frame, and boxing, and the students' actual interest, which lies in self-defense ability.

6.2 To address these challenges, a revision of the Martial arts curriculum is recommended. The content update should adhere to the principle of incorporating both fighting and fitness elements, ensuring Martial arts remain practical. Additionally, the content should align scientifically with the discipline's development, meeting human functional exercise needs for mental health promotion. This curriculum update should consider the acceptable range of harmony and unity, commencing from foundational principles that align with students' psychological development and practicality. The goal is to equip students with mastery of basic Martial arts techniques while balancing the essential attributes of fighting and fitness.

6.3 To optimize the Martial arts curriculum in Shandong universities, a student-centric approach is vital, acknowledging their practical needs and evolving development. Ensuring dedicated teaching hours is imperative. By extending Martial arts optional courses into the third and fourth grades through extracurricular electives or improvement courses, or establishing Martial arts clubs, we can guarantee the continuity of teaching and offer students more time and opportunities to engage with Martial arts. This lays the groundwork for instilling lifelong sports awareness and habits.

6.4 Regarding teaching content, it is crucial to fortify the substance of Martial arts courses. Reducing the emphasis on competition, the curriculum should underscore Martial arts' distinctive attributes, including practicality, cultural significance, mental cultivation, and fitness. The primary focus should be elevating students' Martial arts proficiency, reinforcing safety measures, promoting scientific training, and implementing stringent management practices.

6.5 The establishment of a University Martial Arts Association assumes a pivotal role in providing guidance, cultivating talent, and fostering a vibrant Martial arts culture on campuses. By organizing diverse activities and enhancing campus publicity, we can create an environment conducive to Martial arts learning.

6.6 While competitions serve as a testament to training outcomes, it is notable that Martial arts competitions are notably scarce in Shandong universities. To address this, regular competitions should be held, fostering technical exchange among institutions. Joint training and competitions facilitate mutual learning and collective progress, promoting a flourishing Martial arts scene in Shandong's universities. The sustainable development of higher education institutions hinges on the proficiency of educators. Teaching reform's success relies on continuous enhancements to teachers' levels and quality. Teachers, as both organizers and implementers, should adopt a student-centered approach, continuously refining their teaching abilities. Tailoring content, methods, and forms to students' needs, teachers must meticulously plan and execute lessons, ensuring that each student comprehensively grasps the curriculum.

6.7 The ongoing evolution of Martial arts knowledge necessitates that teachers stay abreast of the times. Continuous professional development and self-cultivation are essential for enhancing Martial arts courses' teaching quality. Establishing a high-level faculty in Shandong universities, characterized by a balanced title structure, appropriate degree levels, and exceptional teaching abilities, is the collective goal. Introducing highly qualified Martial arts teachers and implementing a collaborative training and exchange mechanism



will be instrumental in enhancing teaching prowess. Practical training addressing teachers' professional ethics and quality will further elevate their expertise, fostering continual improvement in Shandong universities' Martial arts education.

In summary, The impact of environmental temperature and humidity factors on Martial arts performance scores in Shandong Province is a critical study area. To optimize performance across varying ecological conditions, Martial arts competitors in Shandong can employ a diverse set of adaptation strategies. Coaches, playing a crucial role in competitor preparation, should prioritize environmental simulation training, implement well-structured and periodized programs, leverage sports science support, and address psychological aspects. Environmental simulation training allows athletes to acclimate to different conditions, enhancing adaptability during competitions. Periodized programs, systematically planned and varied, cater to the demands of diverse environments and competition scenarios. Utilizing sports science support provides access to cutting-edge research and technology, facilitating evidence-based decisions in training methodologies. Moreover, coaches should address psychological aspects, incorporating mindfulness techniques and psychological conditioning to fortify athletes against environmental stressors. This comprehensive approach ensures that Martial arts competitors in Shandong Province are well-equipped to excel under varying environmental circumstances, promoting a resilient and holistic athletic performance.

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