ISSN 2618-1576 Vol. 8, Issue 3: 43-48, DOI: 10.25236/FSR.2026.080307

Research on Adaptive Adjustment Strategies for Badminton Training under Tropical Climate in Haikou

Zhou Xi

Hainan Vocational University of Science and Technology, Haikou, Hainan, 571126, China

Abstract: *Haikou features a typical tropical marine monsoon climate, characterized by year-round high temperature, excessive air humidity, prolonged rainy seasons and intense solar radiation, which creates unique environmental constraints on professional and amateur badminton training. Badminton is a high-intensity intermittent sport that requires precise physical coordination, rapid response and stable technical output. The special tropical meteorological conditions in Haikou not only interfere with the physical state and technical performance of athletes but also easily trigger fatigue accumulation and heat-related sports injuries, restricting the improvement of training efficiency and competitive level. This study adopts field observation, experimental comparison and literature analysis methods to summarize the adverse impacts of high temperature, high humidity and seasonal monsoon weather on badminton training in Haikou. Combined with the actual training characteristics of local badminton teams, it puts forward targeted adaptive adjustment strategies from the aspects of training schedule optimization, technical and tactical training adjustment, physical training adaptation, equipment and venue management, as well as physical recovery guarantee. The research aims to eliminate the negative interference of tropical climate on badminton training, help athletes adapt to local special environmental conditions stably, maintain continuous training state, and provide practical reference for standardized and efficient badminton training in tropical coastal areas.*

Keywords: *Tropical Climate; Badminton Training; Adaptive Adjustment Strategy*

1. Introduction

As a popular competitive and fitness sport, badminton has high requirements for environmental stability, and subtle changes in temperature, humidity and air flow will directly affect the movement trajectory of badminton, the friction state of the venue and the physical exertion of athletes[1]. Different from temperate and subtropical regions, Haikou's tropical climate presents distinct seasonal characteristics. The city has a long hot period every year, with the average annual temperature remaining above 24℃, and the high-temperature period from April to October lasts for more than half a year. The relative air humidity in most seasons is higher than 65%, and the rainy monsoon season is accompanied by frequent humid and sultry weather, forming a typical high-temperature and high-humidity training environment that is rare in inland areas[2].

In daily badminton training practice in Haikou, many coaches and athletes have long been plagued by environmental adaptation problems. Under high-temperature and high-humidity conditions, athletes' sweat evaporation efficiency decreases significantly, resulting in slow body heat dissipation, increased heart load, and premature physical fatigue[3]. Meanwhile, humid air will dampen badminton balls and racket grips, change the string tension and ball flight path, lead to unstable technical performance such as hitting accuracy and net control, and greatly increase the difficulty of daily technical and tactical training. In addition, the alternating hot and rainy weather in the tropical monsoon season often disrupts the fixed training plan, resulting in discontinuous training and affecting the formation of athletes' muscle memory and competitive state.

At present, most domestic and foreign studies on badminton training focus on technical and tactical improvement, physical quality training and injury prevention in conventional environments[4]. There are relatively few targeted researches on the adaptive adjustment of badminton training under tropical high-temperature and high-humidity conditions, and the existing research results lack pertinence to the actual training situation in Haikou. Based on the local meteorological characteristics and training actual situation of Haikou, this study systematically analyzes the restrictive factors of tropical climate on

ISSN 2618-1576 Vol. 8, Issue 3: 43-48, DOI: 10.25236/FSR.2026.080307

badminton training, and constructs a set of scientific and operable adaptive training adjustment system, so as to solve the practical problems encountered in local badminton daily training, and provide theoretical and practical support for the sustainable development of badminton training in tropical coastal regions.

2. Climate Characteristics of Haikou and Its Adverse Effects on Badminton Training

2.1 Typical Tropical Climate Characteristics of Haikou

Haikou is located in the northern part of Hainan Island, belonging to the tropical marine monsoon climate zone. The overall climate characteristics are high annual average temperature, insignificant seasonal temperature difference, high air humidity, abundant rainfall and obvious monsoon alternation[5]. First of all, in terms of temperature, the annual average temperature of Haikou is 24.3℃, the number of days with daily maximum temperature exceeding 30℃ is more than 180 days a year, and the indoor temperature of ordinary training venues often remains above 28℃ in the hot season. Secondly, in terms of humidity, the annual average relative humidity of Haikou is between 75% and 85%. Especially from May to October affected by the southwest monsoon, the air is extremely humid, and the indoor humidity of poorly ventilated training halls can even exceed 90%[6]. In addition, Haikou has a long rainy season with concentrated rainfall, sudden showers and continuous rainy weather, which leads to long-term damp indoor venues and poor air fluidity, forming a typical sultry microclimate environment for training.

2.2 Adverse Impacts on Athletes' Physical State

High temperature and high humidity are the core factors affecting athletes' physical performance in Haikou's badminton training. Under conventional atmospheric conditions, athletes can discharge body heat through sweat evaporation to maintain stable core body temperature[7]. However, in the high-humidity environment of Haikou, the air moisture content is saturated, and the sweat secreted by the human body is difficult to evaporate, resulting in heat accumulation in the body. Long-term training in this state will lead to continuous rise of core body temperature, accelerated heartbeat, increased breathing frequency, and rapid consumption of physical energy. Field training observation shows that athletes who can maintain high-intensity continuous training for 90 minutes in temperate areas will have obvious physical decline after 40 to 60 minutes of training in Haikou's hot and humid environment, with symptoms such as limb soreness, slow reaction and mental fatigue.

In addition, long-term training in tropical humid environments is prone to cause physiological discomfort and sports injuries. Excessive sweating will lead to a large loss of electrolytes such as sodium and potassium in the body, causing muscle cramps, weakness and decreased explosive power. The damp and hot skin environment also increases the risk of skin inflammation and athlete's foot. Meanwhile, the damp ground of the training venue reduces the friction between the sole and the ground, which greatly improves the risk of ankle sprain and sliding fall during rapid starting and stepping movement of badminton training.

2.3 Interference with Technical Training and Equipment Performance

The tropical humid climate in Haikou directly changes the performance of badminton training equipment and affects the stability of athletes' technical movements. Badminton is made of goose feather or duck feather, which is extremely sensitive to air humidity. In high-humidity environment, the feather absorbs a large amount of water vapor, resulting in increased ball weight, reduced elasticity, and slower flight speed. The falling point of the ball is shorter than that in the dry environment, which makes the athletes' habitual hitting strength and angle judgment deviate, leading to frequent errors in technical movements such as high clear, drop shot and net lift.

In terms of racket equipment, high temperature will reduce the tension of racket strings, making the racket feel softer and the hitting power insufficient. The humid air will dampen the hand glue of the racket, resulting in slippery grip, unstable holding racket, and easy shaking of the racket during fast swinging and force exertion, which seriously affects the accuracy of technical output. In addition, the damp training venue will make the ball net absorb water and become heavy and sagging, changing the standard height and tension of the ball net, interfering with athletes' net ball judgment and net pressing technical training, and making the technical training effect deviate from the expected standard.

ISSN 2618-1576 Vol. 8, Issue 3: 43-48, DOI: 10.25236/FSR.2026.080307

2.4 Restriction on Training Plan Implementation

The sudden and continuous rainy weather in Haikou's tropical monsoon season brings great uncertainty to the formulation and implementation of badminton training plans. Many grassroots training venues in Haikou have limited ventilation and dehumidification equipment. After rainy days, the indoor venue is damp for a long time, and it takes a long time to dry and ventilate before normal training can be carried out. Continuous rainy weather often leads to the delay or cancellation of outdoor adaptive training and venue technical training, resulting in fragmented training progress. In addition, the sultry weather easily makes athletes feel irritable and tired, reduces their training enthusiasm and concentration, and leads to low training efficiency, which is not conducive to the accumulation of athletes' technical and tactical abilities and the improvement of competitive state.

3. Adaptive Adjustment Strategies for Badminton Training Adapted to Haikou's Tropical Climate

3.1 Scientific Optimization of Training Time and Intensity Arrangement

Aiming at the high-temperature characteristics of Haikou's tropical climate, the most direct adjustment method is to optimize the training time to avoid the high-temperature period. In the hot season from April to October, the highest temperature in Haikou is concentrated from 10 a.m. to 4 p.m. Therefore, the daily training plan should be adjusted appropriately, arranging high-intensity technical and tactical training and physical training in the early morning (6:30-9:00) and evening (18:00-21:00) with lower temperature and better air circulation. The noon high-temperature period is used for low-intensity auxiliary training such as ball feeling adaptation, technical static correction and tactical video analysis, avoiding high-intensity physical exercise in sultry weather to reduce heat load and physical consumption.

In terms of training intensity, it is necessary to implement the gradient intensity adjustment strategy according to the humidity and temperature changes. In hot and humid days, coaches reduce the duration of single high-intensity confrontation training, appropriately increase the number of rest intervals, and shorten the continuous training time of each group from the conventional 20 minutes to 12 to 15 minutes, with 3 to 5 minutes of full rest between groups.For long-term systematic training, trainers adopt the gradual heat acclimation training method.For athletes who have just entered Haikou for training, coaches arrange medium and low-intensity adaptive training in the first one to two weeks; such training lets the body gradually adapt to the high-temperature and high-humidity environment, and then coaches slowly increase the training intensity and duration, so as to avoid sudden high-intensity training leading to physical discomfort and heat stroke.

3.2 Targeted Adjustment of Technical and Tactical Training Content

When badminton competitions proceed in muggy tropical zones, lingering dampness reshapes shuttlecock flight routes and changes how racket surfaces interact with feather balls, which pushes coaching staff to rearrange regular skill drills according to on-site climate features and foster athletes' unique muscle reflex that adapts to wet competition surroundings. During daily technical lessons, coaches deliberately expand the time slot reserved for strength adaptive practice, as ambient moisture brings tangible changes to on-court hitting effects. After absorbing surrounding moisture, feather shuttlecocks turn noticeably heavier and fail to glide as far as under dry weather; for this practical hurdle, players receive concentrated repetitive training to regulate swing strength and fine-tune hitting inclination. With plenty of repetitive on-court drills, competitors can naturally step up swing output and alter ball-launch angles spontaneously once stepping into humid matches, effectively fixing irregular hitting habits formed from inconsistent environmental conditions.

Net-based strokes suffer the most obvious interference from humid air, so training schedules raise the frequency of net lift, net push and net press exercises carried out under artificially humidified training courts. Constant repetitive attempts allow athletes to get familiar with slackened damp net tape and the slow floating trend of waterlogged shuttlecocks, steadily boosting their judgement precision and on-the-spot disposal ability facing tricky net incoming balls. From the tactical training perspective, sticky hot weather wears down athletes' physical reserve rapidly, meaning coaches need to trim lengthy cross-court rally drills that consume massive physical energy. In replacement, more tight front-net contention plus short-distance quick attack and defence drills fill the vacant training hours. Such adjustment fits tropical climate's slow ball velocity and athletes' declined endurance level, letting all

ISSN 2618-1576 Vol. 8, Issue 3: 43-48, DOI: 10.25236/FSR.2026.080307

practiced tactics better match real-game needs, and coaches will also record athletes' in-training tactical execution data to adjust subsequent drill intensity flexibly.

3.3 Adaptive Improvement of Physical Training and Recovery Guarantee

Physical fitness programmes designed for tropical training environments centre on three core indicators: heat endurance, lasting stamina and fast bodily recovery capacity. Apart from conventional basic fitness exercises covering muscle strength and cardio workout, coaches add exclusive heat acclimation modules, such as long-hour low-speed shadow footwork and uninterrupted fixed-point hitting inside temperature-controlled high-humidity simulation venues, which gradually lift trainees' body heat dissipation efficiency and upper limit for enduring sweltering surroundings. Meanwhile, high-load anaerobic explosive workouts get cut down significantly in hot rainy seasons; overstrenuous physical exertion triggers excessive lactic acid deposition inside muscle fibres, greatly raising the odds of extreme tiredness and accidental muscle strain during subsequent training sessions.

Well-planned water and electrolyte replenishment acts as the pivotal part of fatigue restoration amid tropical training cycles. Every coach drafts detailed daily drinking guidelines tailored to team training rhythm: athletes take in 500 millilitres warm electrolyte liquid half an hour before formal drills start, and drink 200 millilitres mineral supplement drinks every 15 to 20 minutes during short training pauses, offsetting water and inorganic salt losses caused by profuse sweating all over the body. Right after each training session ends, coaches organize customized relaxation courses without delay, ranging from full-body passive stretching and manual deep-tissue massage to local hot compress care, all aiming to ease muscular soreness and disperse accumulated fatigue efficiently. When arranging daily team meals, catering personnel increase portions of high-protein ingredients and vitamin-rich fresh fruits and vegetables, meanwhile adding proper potassium and sodium nutritional supplements in regular dishes. These dietary modifications accelerate physical energy replenishment day by day, helping athletes maintain stable training condition and avoid falling into persistent fatigue that hinders long-term training progress.

3.4 Standardized Management of Venues and Equipment

The scientific management and optimal adjustment of training sites and sports equipment serve as a key auxiliary strategy to eliminate the adverse impacts brought by tropical high-temperature and humid weather on badminton training. For indoor training venues, daily environmental regulation work focusing on ventilation and dehumidification should be implemented in a normalized manner. In days with continuous rainfall and excessive air humidity, staff need to start professional dehumidification equipment and ventilation exhaust devices ahead of schedule to lower indoor humidity levels. Meanwhile, manual mopping and professional ground drying tools are adopted to process the site ground, making sure the training area stays dry, clean and flat before all training sessions start. Routine inspection and maintenance of the venue's anti-slip coating are also essential, which can effectively enhance ground friction force and greatly reduce the slipping and falling risks of athletes during skill practice and physical training. As for the net accessories that are prone to damp deformation in humid air, trainers need to remove and spread them for natural or mechanical drying once they absorb moisture, and install them back only after the nets reach the standard dry state, so as to keep the net height and tension consistent with official competition standards at all times.

In terms of daily equipment application and maintenance management, targeted adjustment measures should be taken for the hot and humid tropical climate. Coaches are advised to guide athletes to choose badminton racket strings with moderately higher tension for daily use, which can effectively compensate for the tension loss caused by long-term high temperature and humid air exposure. The hand grip glue on rackets shall be replaced regularly to avoid dampness and slippage, ensuring athletes can maintain stable gripping friction and control flexibility during training. In daily storage management, badminton balls must be placed in constant-temperature dry storage cabinets to prevent the fluff and internal structure from absorbing moisture. Before each training, coaches only need to take out a proper quantity of balls for use. It is forbidden to place a large number of badminton balls in the open and humid training environment for a long time, which can prevent changes in ball weight, flight track and bounce performance caused by moisture absorption, and guarantee the stability of training effect.

ISSN 2618-1576 Vol. 8, Issue 3: 43-48, DOI: 10.25236/FSR.2026.080307

3.5 Flexible Adjustment of Training Plan in Monsoon and Rainy Season

The tropical monsoon climate in Haikou features sudden rainfall and unstable weather conditions, which brings great uncertainty to outdoor and indoor venue training. To solve this problem, a flexible training mode with indoor alternative courses as the backup scheme should be formulated. When continuous rainy weather leads to severe venue dampness and makes technical skill training unfeasible, the training arrangement can be rapidly switched to indoor core physical quality training, tactical knowledge explanation and learning, match video analysis and technical action standardized correction training. This flexible switching mode can effectively avoid the interruption of daily training progress and ensure the systematicness and continuity of athletes' daily training accumulation. For short-term intermittent rainy weather, training staff should seize the rain stopping gap to carry out venue ventilation and dehumidification treatment, and arrange segmented and fragmented technical training sessions to make up for the training time affected by rainfall, maximizing the utilization of limited training time.

In addition to physical training arrangement, athletes' mental state regulation under rainy and sweltering weather is also a key part of training management. Long-term exposure to humid, stuffy and oppressive training environments tends to make athletes prone to emotional irritability, training slackness and negative fatigue psychology, which will seriously affect their training efficiency and state. Coaches can enrich daily training forms and formulate reasonable personalized incentive rules according to athletes' training conditions. Diversified training content and positive incentive measures can fully stimulate athletes' training initiative, alleviate mental pressure and environmental discomfort caused by bad weather, and ultimately maintain stable training quality and competitive state of athletes in special monsoon rainy seasons.

4. Conclusion

The special tropical high-temperature, high-humidity and monsoon rainy climate in Haikou has multiple negative impacts on badminton training, covering athletes' physical state, technical and tactical performance, equipment stability and training plan implementation, which are important restrictive factors for the improvement of local badminton training level. Combined with the actual training environment and meteorological characteristics of Haikou, this study constructs a set of adaptive adjustment strategies from multiple dimensions including training time and intensity optimization, technical and tactical training adjustment, physical recovery guarantee, venue and equipment management, and rainy season plan flexibility. These strategies can effectively reduce the negative interference of tropical climate on badminton training, improve athletes' environmental adaptation ability and training efficiency, and reduce the occurrence of sports injuries.

In the future, badminton training in Haikou should adhere to the climate-adaptive training concept, further refine the training adjustment standards according to different training stages and athlete groups, combine modern sports monitoring technology to dynamically track athletes' physical changes and environmental data, and continuously optimize the adaptive training system. It is expected that the research results can provide practical guidance for badminton training in tropical coastal areas, and promote the standardized and high-quality development of badminton sports in special climatic environments.

References

[1] Sun M . Wearable Data-Driven Transformer Model for Physical Load Assessment in Badminton Training [J]. Engineering Reports, 2026, 8 (3): 718. DOI:10.1002/ENG2.70718.

[2] Zhang Y ,Duan W ,Villanueva E L , et al. Retraction Note: Designing a training assistant system for badminton using artificial intelligence [J]. Soft Computing, 2026, (prepublish): 1. DOI:10.1007/S00500-026-11260-8.

[3] Zhou X . A Longitudinal Study on the Role of Long-Term Badminton Training in Shaping the Willpower of Adolescents [J]. Journal of Social Science and Cultural Development, 2026, 2 (9): DOI:10.70767/JSSCD.V2I9.830.

[4] Bondarenko V V ,Prontenko V K ,Bykova V H , et al. Physical and sports rehabilitation of patients with amputations using adaptive badminton. [J]. Wiadomosci lekarskie (Warsaw, Poland : 1960), 2026, 79 (2): 310-316. DOI:10.36740/WLEK/218719.

[5] Wei C ,An J ,Lin Y , et al. The effects of 8 weeks of repeated sprint training on aerobic endurance,

ISSN 2618-1576 Vol. 8, Issue 3: 43-48, DOI: 10.25236/FSR.2026.080307

anaerobic power, agility and explosive strength in college badminton players. [J]. PeerJ, 2026, 14 e21111. DOI:10.7717/PEERJ.21111.
[6] Yang H ,Chen A . Impact of Badminton Training on Adolescents' Social and Emotional Regulation Ability [J]. Frontiers in Sport Research, 2025, 7 (5): DOI:10.25236/FSR.2025.070516.
[7] Zhu L ,Tan X ,Li T , et al. BMI-stratified outcomes of a badminton training program on health-related fitness in adults with mild to moderate intellectual disabilities [J]. Frontiers in psychiatry, 2025,301. DOI:10.3389/FPSYT.2025.1625301.