

INFLUENCE OF HIGH-INTENSITY TRAINING ON THE TAEKWONDO ATHLETES' PERFORMANCE



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INFLUÊNCIA DO TREINO DE ALTA INTENSIDADE NO DESEMPENHO DOS ATLETAS DE TAEKWONDO

INFLUENCIA DEL ENTRENAMIENTO DE ALTA INTENSIDAD EN EL RENDIMIENTO DE LOS ATLETAS DE TAEKWONDO

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ABSTRACT

Introduction: Taekwondo athletes' performance is affected by their level of physical fitness. High-level athletes must have good physical fitness to perform difficult techniques and complex sets of movements with high specificity. **Objective:** Verify the influence of high-intensity training on fitness levels for the selection and daily training of taekwondo athletes in colleges and universities. **Methods:** In this study, 47 high-level taekwondo athletes from the Capital Institute of Physical Education were considered and statistically analyzed employing literature, expert interview, tests, mathematical statistics, and logical analysis. The factors influencing physical fitness were determined. **Results:** Five first-level, nine second-level, and 15 third-level test indicators based on the combination of general fitness and specific fitness of athletes were determined. Fitness test analysis was performed before and after 12 weeks of daily high-intensity training demonstrating that the athletes' physical quality showed an upward trend, especially in terms of strength, endurance, and flexibility. Still, speed and agility showed no statistical change. **Conclusion:** Fitness training of high-level taekwondo athletes should be combined with particular techniques, focusing on training the five qualities of strength, speed, endurance, agility, and flexibility. It is recommended to individually plan the training cycle and intensity of each training session, to carry out a targeted training plan, and to ensure a training plan with regularity. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

Keywords: Physical Education and Training; Martial Arts; Physical Fitness.

RESUMO

Introdução: O desempenho do atleta de Taekwondo é afetado pelo seu nível de aptidão física. Atletas de alto nível devem ter uma boa aptidão física para executar técnicas difíceis, e conjuntos complexos de movimentos com alta especificidade. **Objetivo:** Verificar a influência do treino de alta intensidade no nível de aptidão física para a seleção e treinamento diário dos atletas de taekwondo em faculdades e universidades. **Métodos:** Neste estudo, 47 atletas de alto nível de taekwondo do Instituto Capital de Educação Física foram considerados e analisados estatisticamente por meio de literatura, entrevista com especialistas, testes, estatísticas matemáticas e análises lógicas. Foram determinados os fatores que influenciam a aptidão física. **Resultados:** Foram verificados cinco indicadores de teste de primeiro nível, nove de segundo nível e 15 de terceiro nível com base na combinação de aptidão física geral e aptidão específica dos atletas foram determinados. A análise do teste de aptidão física foi executada antes e depois de 12 semanas de treinamento diário de alta intensidade demonstrando que a qualidade física dos atletas apresentou uma tendência ascendente, especialmente em termos de força, resistência e flexibilidade, mas a velocidade e a agilidade não demonstraram alterações estatísticas. **Conclusão:** O treinamento de aptidão física dos atletas de taekwondo de alto nível deve ser combinado com técnicas particulares, concentrando-se no treinamento das cinco qualidades de força, velocidade, resistência, agilidade e flexibilidade. Recomenda-se planejar individualmente o ciclo de treinamento e a intensidade de cada treinamento, realizar um plano de treinamento direcionado e garantir um plano de treinamento com regularidade. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

Descritores: Educação Física e Treinamento; Artes Marciais; Aptidão Física.

RESUMEN

Introducción: El rendimiento de los deportistas de taekwondo se ve afectado por su nivel de condición física. Los atletas de alto nivel deben tener una buena forma física para realizar técnicas difíciles y conjuntos de movimientos complejos con gran especificidad. **Objetivo:** Verificar la influencia del entrenamiento de alta intensidad en el nivel de aptitud física para la selección y el entrenamiento diario de los atletas de taekwondo en colegios y universidades. **Métodos:** En este estudio, se consideraron 47 atletas de taekwondo de alto nivel del Instituto de Educación Física de la Capital y se analizaron estadísticamente por medio de la literatura, la entrevista a expertos, las pruebas, la estadística matemática y el análisis lógico. Se determinaron los factores que influyen en la aptitud física. **Resultados:** Se determinaron cinco indicadores de prueba de primer nivel, nueve de segundo nivel y 15 de tercer nivel basados en la combinación de la aptitud física general y la específica de los deportistas. El análisis de las pruebas de aptitud física se realizó antes y después de 12 semanas de entrenamiento diario de alta intensidad, lo que demostró que la calidad física de los atletas mostraba una tendencia ascendente, especialmente en términos de fuerza, resistencia y flexibilidad, pero la velocidad y la agilidad no mostraron cambios estadísticos. **Conclusión:** El entrenamiento físico de los atletas



de taekwondo de alto nivel debe combinarse con técnicas particulares, centrándose en el entrenamiento de las cinco cualidades de fuerza, velocidad, resistencia, agilidad y flexibilidad. Se recomienda planificar individualmente el ciclo de entrenamiento y la intensidad de cada sesión de entrenamiento, llevar a cabo un plan de entrenamiento dirigido y garantizar un plan de entrenamiento con regularidad. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.**

Descriptores: Educación y Entrenamiento Físico; Artes Marciales; Aptitud Física.

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INTRODUCTION

In terms of promoting the comprehensive and healthy development of human beings, health is an inevitable requirement. This is pointed out in the "Healthy China 2030" Plan Outline. At the same time, in the process of building a healthy China, the core goal is to improve people's health level. In the comprehensive health system, the most critical component is the healthy physique of students, which is related to the great dream of building a healthy China. The notice issued by the General Office of the State Council related to the construction of a strong sports country clearly stated that in 2035, more than 92% of urban and rural residents should meet the passing requirements in the "National Physical Fitness Determination Standards", and "the first person to be self-confident." In all special sports in sports, the key component of each ability is physical quality, which can determine the performance that an athlete can achieve to a certain extent. Taekwondo is basically a comprehensive sport of physical fitness and technology.^{1,2} The level of competition performance is closely related to the athletes' special sports ability. Regarding the sports performance of athletes in competitions, the most critical factor is the special sports ability. In the process of arranging various movements and rhythms of the competition, taekwondo athletes constructed one competition and performance one after another on the basis of various difficult movements. However, only when taekwondo athletes have excellent physical fitness can they be able to perform. A complete set of movements is fully displayed, and physical fitness refers to the physical functions of athletes themselves in various sports. After the quality training is implemented on the athletes' bodies, they can quickly enhance their physical functions, so that the athletes can also have an excellent state under the extremely strong exercise load. As far as taekwondo athletes are concerned, the requirements for their physical fitness are more stringent. The athletes' various athletic abilities can be reflected in their physical fitness, and the level of their athletic ability will also be directly affected by their physical fitness. The core elements reflect the ability of the athlete in the competitive process. By studying the current situation of physical fitness of high-level taekwondo athletes in my country and determining the influencing factors of their physical fitness, this paper puts forward scientific and reasonable suggestions for improving athletes' daily training level and improving their physical fitness, and provides quantitative indicators for the selection of outstanding taekwondo athletes in colleges and universities in terms of physical fitness.³

RESEARCH OBJECTS AND RESEARCH METHODS

Research objects

The article takes the physical fitness and its influencing factors of the 2021 class 47 Taekwondo high-level athletes of the Capital Institute of Physical Education as the research object.

Research methods

Literature Review Method

The literature data method is to use large databases to consult literature, including foreign language databases such as CNKI, VIP, provincial libraries, and Science Direction, to consult domestic and foreign

experts and scholars' papers and books on athletes' physical fitness, to collect and analyze them. Summarize the research progress in this area at home and abroad, determine the research direction and significance, and provide a strong scientific basis for the development of the paper.

Expert Interview Method

Using the expert interview method, the physical fitness test indicators of the high-level Taekwondo athletes of the Capital Institute of Physical Education were initially screened, and the physical fitness indicators were screened by collecting the data of the second round of expert questionnaires. The main experts selected are national-level coaches and national-level referees who have been engaged in taekwondo training and practice for a long time, as well as professors who have been conducting research in the field of competitive taekwondo.

Cut-and-try method

The participating athletes were divided into two groups according to their gender, and they were tested for strength, speed, endurance, flexibility and agility.

Basic information of the tested athlete

A total of 47 high-level taekwondo athletes in the 2021 class were selected from the Capital Institute of Physical Education as the test subjects of this research. The number of male athletes were 28 (height-175.40±4.15 cm & weight 64.30±3.83) and female athletes is 19 (Height -164.27±4.07 & weight 55.27±6.69 kg)

Testing process

According to the requirements of the test, in advance, please invite people with test experience, including two graduate students from the sports measurement and evaluation major and two graduate students from the sports rehabilitation department, to formulate a reasonable test method to ensure the accuracy of the test data and reduce as much as possible. Error, 47 high-level taekwondo athletes were subjected to a 12-week high-intensity daily training physical fitness test from September 14 to 16, 2021 and December 7 to 9, 2021, and the test locations were in the gymnasiums of each school.

Development of test method standards

The test standards and related rules for high-level taekwondo athletes are based on the indicators that need to be tested and refer to the national physique monitoring standards, and refer to the physical fitness indicators, test methods, evaluation standards and other relevant literature of athletes, and refer to the book "Sports Measurement and Evaluation". A large number of test methods used in the study are consistent with the "Sports Training Science", with high accuracy and scientificity, to ensure the authenticity and reliability of the data of the physical fitness test results of high-level Taekwondo athletes of the Capital Institute of Physical Education.

The authors state that the research was conducted in accordance with the principles embodied in the Declaration of Helsinki. The participants participated in this study and signed the free and informed consent term (EHIC). The authors confirming that consent was given for publication by all participants.

Mathematical Statistics

The EXCEL2010 software was used to input the data of the physical fitness test of high-level taekwondo athletes in three colleges and universities, and the data was processed and analyzed by the statistical analysis software SPSS19.0.

The AHP analytic hierarchy process is used to determine the weight ranking of various factors that affect physical fitness, and the AHP analytic hierarchy process can be used to quantify the judgment experience and improve the correctness of the weight ranking of the influencing factors.

Logical analysis

According to the existing relevant literature, through the exploration and analysis of various physical fitness items in Taekwondo, and summarizing the suggestions of experts, screening the physical fitness test indicators of high-level Taekwondo athletes in the Capital Institute of Physical Education and ranking the influencing factors by importance, and finally carry out logical analysis and sorting out relevant conclusions and suggestions

RESULTS AND DISCUSSION

Determination of Physical Fitness Test Index of High-level Taekwondo Athletes in Capital Institute of Physical Education

In this study, the selection of physical fitness test indicators for high-level taekwondo athletes in capital colleges and universities is mainly to refer to the relevant content in the books "Sports Measurement and Evaluation", "Sports Training" and "Taekwondo", and extensively solicit questions from physical taekwondo experts, On the basis of the opinions of coaches and referees, combined with the actual situation of the characteristics of Taekwondo, the screening of physical fitness test indicators is carried out.^{4,5}

Analysis of the results of the first round of expert screening of physical fitness test indicators

In the preliminary design and compilation of the expert opinion questionnaire, the strength quality, speed quality, endurance quality, flexibility quality and agility quality were set as the first-level test indicators of this study, and after passing the first round of expert opinion survey, it was concluded. The pass rate of the first-level test indicators are all 100%, and the expert opinions are unanimously reserved. Therefore, the above five physical fitness indicators can be used as the first-level test indicators in this study. Explosive power, strength endurance, movement speed, anaerobic endurance, aerobic endurance, upper and lower limb flexibility, general agility and special agility have higher pass rates, so they can be retained as the test indicators in the second round of expert opinion questionnaires.

The three-level test indicators in Table 1: the pass rate of the test indicators of supine leg raising is low, less than 50% does not meet the inclusion criteria, so it was deleted in the design of the second round of expert opinion questionnaires, and the rest of the test indicators Then enter the second round of expert survey opinion form preparation, and adopt the suggestions made by experts, revise and adjust some test indicators.

Analysis of the results of the second round of expert screening of physical fitness test indicators

The screening results of the physical fitness test indicators in the first round of expert opinion questionnaires were sorted and summarized, and the expert opinion questionnaires were improved. The second round of the expert opinion questionnaire uses the Likert five-level scale. Experts are asked to re-screen the physical fitness test indicators

in the second round and score them according to their importance (1=very unimportant, 2=not so important, 3=moderately important, 4=somewhat important, 5=very important).

In the research of this paper, the mean value is required to be greater than 4.0, and the coefficient of variation mainly reflects the degree of disagreement among experts on the indicators. The smaller the coefficient of variation, the higher the degree of coordination.

Survey results and analysis of primary indicators

The results of the first-level indicators were counted by the second round of experts. The average value of the first-level test indicators was 5 points, and the overall consensus of the experts was good ($V_i=0.000$).

Secondary Index Survey Results and Analysis

Through the second round of experts statistics on the results of the secondary indicators, the average value of the indicators is more than 4 points, it can be seen from Table 2 that strength and flexibility occupy an important position, which is also in line with the characteristics of athletes, and The consensus of experts' opinions was good ($0.000 < V_i < 0.166$).

Table 1. The first round of expert screening of taekwondo high-level athletes' physical fitness test indicators.

First-level indicator name	Secondary indicator name	Passing rate	First-level indicator name	Whether selected
Strength quality	Explosive power	Lift handstand	72%	Retain
	Strength endurance	Handstand Push-Ups	42%	Retain
		1min lie on your back	86%	Retain
		Leg Raise	28%	Delete
Speed quality	Movement speed	10s jumping jack	72%	Retain
		10s Leg raises in situ	72%	Retain
		30s fast kick run	57%	Retain
Endurance quality	Anaerobic endurance	30s body split jump	86%	Retain
	Aerobic endurance	plank	86%	Retain
Flexibility quality	Lower limbs flexible	parallel split	100%	Retain
		Longitudinal fork (left, right)	100%	Retain
		Upper limbs flexible	Rope around shoulder	86%
Sensitive quality	General sensitive	3 * 10m turn back run	72%	Retain
	Special sensitive	Cross-step 20m round-trip run	86%	Retain

Table 2. Statistical results of the mean and coefficient of variation of the secondary indicators.

Secondary indicators	Mean value	Standard deviation	Variable coefficient
Explosive power	4.29	0.488	0.113
Strength endurance	4.14	0.690	0.166
Movement speed	4.00	0.577	0.144
Anaerobic endurance	4.43	0.534	0.120
Aerobic endurance	4.14	0.378	0.091
Lower limbs flexible	5.00	0.000	0.000
Upper limbs flexible	4.86	0.378	0.077
General sensitive	4.14	0.378	0.091
Special sensitive	4.29	0.487	0.113

Three-level indicators survey results and analysis

Through the second round of experts' statistics on the results of the three-level indicators, the average value of the indicators is above 4.0 points, and the consensus of experts' opinions is good ($0.000 < Vi < 0.167$), as shown in Table 3.

Through the statistical results of the expert questionnaire survey, the physical fitness test indicators of the high-level Taekwondo athletes of the Capital Institute of Physical Education were finally determined. These test indicators include 15 third-level indicators, 9 second-level indicators and 5 first-level indicators.

Analysis of the results of physical fitness characteristics of high-level taekwondo athletes in Capital Institute of Physical Education

The analysis of the physical fitness test of high-level taekwondo athletes in the Capital Institute of Physical Education before and after 12-week daily training shows that the physical fitness of athletes shows an upward trend, especially in terms of strength, endurance and flexibility, but the speed and sensitivity have not changed much. However, strength, speed, endurance, flexibility and agility have different effects on the reasonable training of Taekwondo athletes. During training, attention should be paid to the combination of general physical fitness and special physical fitness, so that when complex and difficult movements are displayed in fierce competitions, the movements can be completed.^{5,6}

Investigation results and analysis of strength quality characteristics

As shown in Table 4, the test results of high-level taekwondo athletes of Capital Institute of Physical Education in the test results before and after 12-week daily training showed significant differences among male athletes ($P < 0.05$). Among female athletes, only the hip lift was the one. There was no very significant difference in the items ($P > 0.05$), and several other items were consistent with the male athletes, showing significant differences. This fully demonstrates that after 12 weeks of high-intensity training, the taekwondo athletes of the Capital Institute of Physical Education have developed well in terms of strength. The technical action of raising the buttocks is more difficult and requires higher physical fitness. Because female athletes have an inherent disadvantage compared to male athletes in terms of strength and quality, they have not been significantly improved in a short period of time. In terms of strength and quality, both male and female athletes can effectively improve the level of strength and quality under the action of uninterrupted professional training and maintaining a healthy lifestyle, so as to strengthen the strength of athletes' technical movements, so that athletes can show Taekwondo of health, strength and beauty.^{7,8}

Investigation results and analysis of speed quality characteristics

As shown in Table 5, in the test results of high-level taekwondo athletes of Capital Institute of Physical Education before and after 12 weeks of daily training, there was no particularly significant change in the speed indicators of taekwondo men and women in each group ($P > 0.05$), indicating that after 12 Weekly training life, the speed quality of high-level taekwondo athletes of the Capital Institute of Physical Education has not developed significantly. It is difficult to improve the speed quality level in a short period of time, because the athletes have a strong ability in terms of speed, which can be improved. The space is very limited, but if the athletes have good speed quality, they can follow the rhythm of the music and show more difficult movements more smoothly. Carry out scientific training according to the athlete's own situation.^{4,6}

In daily training activities, taekwondo athletes mainly train on the five qualities of strength, speed, endurance, flexibility and agility based

Table 3. Statistical results of the mean and coefficient of variation of the three-level indicators.

Three-level indicators	Mean value	Standard deviation	Variable coefficient
Butt lift	4.57	0.535	0.117
Lift handstand	4.42	0.535	0.121
Handstand Push-Ups	4.28	0.488	0.114
1min lie on your back	4.57	0.535	0.117
10s jumping jack	4.29	0.488	0.113
10s Leg raises in situ	4.29	0.488	0.113
30s kick and run fast	4.29	0.488	0.113
30s body split jump	4.57	0.535	0.117
Plank	4.14	0.690	0.166
Cross fork	5.00	0.000	0.000
Longitudinal fork (left, right)	5.00	0.000	0.000
Rope around shoulder	4.57	0.535	0.117
Sit and reach	4.86	0.378	0.077
3*10m turn back run	4.13	0.690	0.167
Cross-step 20m round-trip run	4.43	0.535	0.120

Table 4. Comparison of strength and quality of high-level Taekwondo athletes in Capital Institute of Physical Education. (n=47)

Gender	Index	Pre-test	Post test	t	P
Male	Lift handstand	5.45±1.57	5.95±1.53	-3.68	0.00*
	Butt lift	22.9±3.65	24.0±3.17	-4.06	0.00*
	Handstand Push-Ups	35.6±2.60	37.75±2.02	-6.14	0.00*
	1min lie on your back	61.2±1.96	64.4±3.48	-6.02	0.00*
Female	Lift handstand	19.44±1.50	20.0±1.22	-3.16	0.01*
	Butt lift	2.44±0.88	3.0±1.11	-3.16	0.13*
	Handstand Push-Ups	19.0±1.65	20.0±1.58	-6	0.00*
	1min lie on your back	53.11±1.61	54.89±2.26	-4.88	0.00*

Note: * means $P < 0.05$, there is a significant difference.

Table 5. Comparison of speed and quality of high-level Taekwondo athletes in Capital Institute of Physical Education. (n=47)

Gender	Index	Pre-test	Post test	t	P
Male	10s jumping jack	16.0±1.0	16.0±0.7	0.00	1.0
	10s leg raises in situ	29.0±1.87	29.4±1.81	-1.0	0.37
	30s quick kick run	59.0±2.44	60.2±1.48	-2.44	0.07
Female	10s jumping jack	14.33±0.86	14.67±1.0	-2.0	0.08
	10s leg raises in situ	19.0±1.58	19.33±1.41	-2.0	0.08
	30s quick kick run	49.89±1.37	50.22±1.13	-2.23	0.05

Note: * means $P < 0.05$, there is a significant difference.

on the standard of complete sets of movements. During the training process, neither choose low-intensity, low-load, small-targeted sports, nor choose overloaded sports, so as to avoid fatigue or sports injuries, and set the time, intensity and intensity of each training reasonably according to your own situation, number of physical training sessions per week. At the same time, it is also necessary to develop good eating and living habits, ensure the regularity of three meals and a balanced diet, reduce the intake of high-calorie foods and the number of late-night snacks, ensure regular work and rest time and sufficient rest time, and avoid all unhelpful food. Hobbies, such as: drinking, smoking, etc. It is necessary to cultivate the good hobby of daily physical exercise, and at the same time strengthen the cultivation of tenacious willpower and focus on the concept of improving personal physical fitness.^{9,10}

Use scientific, reasonable and effective training methods to treat individual athletes, and formulate relevant training plans according to different training goals. The physical fitness training of high-level taekwondo athletes should be combined with special skills. For example, there is a big difference between improving the special difficulty and the special quality required to complete the complete set of exercises.

Therefore, through the analysis of training goals, it is necessary to follow the principle step-by-step and differentiated treatment, according to the differences of each athlete's real level, potential ability, different special skills and objective conditions. Scientifically arrange the training period and the intensity of each training to ensure the regularity of training and a scientific and reasonable training plan.

CONCLUSION

The analysis of the physical fitness test of high-level taekwondo athletes from the Capital Institute of Physical Education before and after 12 weeks of high-intensity daily training shows that the physical

fitness of the athletes shows an upward trend, especially in terms of strength, endurance and flexibility, but the speed and sensitivity have not changed much.

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