

Based on the SPSS Software t⁺ of Weight Control on Taekwondo Athletes' Body Function Influence Research

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Abstract: Weight control has become the ideal level of Taekwondo athletes participate in the competition the important method. According to the nine elite Taekwondo athletes as the research samples, research mainly by using the method of experiments, the experiments were carried out at six weeks, 1 times a week to sweat ion and the anaerobic capacity test and the four body fat content of the test, t test method for analysis of pre-race weight control on Athletes' body function influence. Results showed that, after a period of six weeks after the athlete's weight control, were highly significant changes in weight control; from the beginning of the third week, athlete's body weight and body fat content began to drop dramatically; through the test showed the percentage of body fat and lean body mass were decreased significantly; the anaerobic exercise capacity in athletes the weight control period was not changed significantly; from the beginning of the third week athletes sweat sodium and calcium ion concentration increased significantly, while carbon dioxide binding force is greatly reduced, until the end of sixth week weight control. By the appropriate increase in relaxation time and increase training of aerobic training proportion, can realize the athletes in weight control process to consume fat goal primarily, can provide excellent athletes to provide beneficial reference for weight control research.

Keywords: Athlete, physical function, taekwondo, weight control

INTRODUCTION

Research status: Current, excellent athletes have annual fitness plan, but there is always some athletes are approaching at the start of the game there are still a weight problem, is the concentrated expression of the excess weight ideal match grade. If an athlete can't reach the ideal competitive weight grade, their potential will be greatly affected. Through literature, found that the athlete's weight control research is many. But after further analysis found that, the majority of these studies have focused on the level of methodology. The main study is aiming at different exercise programs, how the concrete implementation method of weight control. After years of practice, can be said for the coaches and athletes, the specific method is not so difficult. The crucial question is carrying out a weight control method for athlete's movement function exists after all what kind of influence. For such key problems, research now is mentioned (Silvestre *et al.*, 2006).

Nowadays many domestic and foreign scholars are studying how to make both the athletes to achieve the ideal weight and can maintain the normal training intensity and volume of training, but also to ensure the best state to participate in the competition. Therefore, before the process of weight control, ensure the athletes' body function status and exercise capacity under the premise of achieving the target weight. It is apart from tactical and other important factors in sports training.

Weight control is a comprehensive system engineering, which in addition to the outside and special training, exercise, nutrition, recovery and other factors will pass through the body metabolism and energy metabolism affect the athlete's functional status and exercise capacity. Athletes in the period of weight reduction by high intensity training, makes airframe heavy perspiration. It will cause the body environment changes. Heavy Athletics athlete's lower body weight of the main purpose is to improve the athletes' competitive ability. Athletes' ability to a certain extent associated with weight (Science and Technology Report, 1982). When training, athletes' cardiovascular function and weight is often proportional. The relationship between weight and cardiac output is clear. Both players rest cardiac output or vigorous exercise of maximal cardiac output, are associated with weight. Athletes in training during weight greatly, can obtain larger cardiac output, but during the game properly to reduce weight, relative per kilogram of body weight gain of cardiac output will increase obviously, which to a certain extent can improve athletes' Sports ability. Therefore, in order to achieve weight reduction before competition is "small machine, big power" effect, thereby improving the capacity of sports and competition achievement. Taekwondo athletes should be based on the game schedule or competition cycle, reasonable adjusting their weight. The weight control purpose is very clear, is to match the purpose and

mission, combined with their competitors and the actual situation, a reasonable weight control, regulate their optimal weight. The expansion of their own advantages, but also for the benefit of the negative, can be obtained in competition can achieve the best possible results and rankings (Binghong and Enli, 2006).

Research purposes: Taekwondo athlete weight control significance is many sided, from the point of athletes, through the weight control; players can obtain better result and ranking, which is conducive to enhancing the athletes on the later game win confidence, stimulate their positive training in emotion and always maintain a high morale. From the perspective of the coaches, weight control theory, will increase the complexity of the game, this complexity will stimulate the coaches to explore, learn more training methods and tactics theory, further enhance their level of training and team level. It will be helpful for our country to bring up a group of high level team of coaches. The Taekwondo Athletes' weight control, no doubt on the weight control theory research also will have the very big promotion effect. The weight control, athlete's weight class is very moving space, they can according to the tactical needs often adjust their weight classes, leapfrog, degradation, as well as undifferentiated stage matches will be more exciting, this is helpful for Taekwondo tactics is unceasingly rich and the development, but also conducive to the development of Taekwondo sports market.

The innovation of research: The innovation of this study is through the use of extended training after finishing activity increases with time and long time in low intensity aerobic exercise means, in a period of 42 days, the nine will be relegated to the Taekwondo athletes were slow weight reduction; at the same time, the motor ability of monitoring and analysis. And according to athletes during the period of the inorganic salt daily requirements, deployment of a certain concentration of electrolyte drink for the athletes to drink, at the same time with weight control program regularly on serum ion testing, monitoring athletes electrolyte metabolic conditions. According to the test results, provide adjusting suggestions. Different means of crossover cooperative, for athletes to get good results to provide protection.

RESEARCH OBJECTS AND METHODS

Study of subjects: Research for a sample of nine elite Taekwondo athletes, distribution of age is in 21~27 year old, specific conditions (Table 1).

Research methods:

- **Weight control program set:** This study implemented a time period of 42 days. On the weight control measure before the athlete's weight and skin fold thickness, calculate the percentage of body fat and according to the athletes' level to determine the athlete individual weight control program. Weight control was measured after the athlete's weight and skin fold thickness, weight control effect evaluation. Weight control process, by appropriately increasing aerobic exercise and reasonable can achieve the purpose. To burn off fat mainly aerobic exercise program for:
- Extend the athlete training after finishing activities to reduce the training time after lactic acid, each extending 30~40 min, control of heart rate in 120 time around/min. Organize activities by coach themselves, generally with soothing rhythm rhythmic gymnastics.
- The weekly increase of 2~3 swimming or jogging, aerobics, aerobics for each time of sustained exercise heart rate control in 1 h, 141 min. Every morning at 07:00 weight measurement, every week one, three, five in the morning 07:00 measurements of skin fold thickness, calculate the body fat percentage. According to the measured weight and body fat percentage weight loss programs to ensure continuous adjustment, weekly uniform decrease a quantity weight. Every two weeks with a motor ability test, based on the measured results of evaluation of athletes' sports ability, feedback to the instructor and adjust the training plan.
- **Sports drink configuration:** According to the athletes during the training period of inorganic salt daily requirement, every afternoon, before training as key players preparation containing sodium, potassium, chloride, calcium and plasma electrolyte drinks and with weight control program every two weeks (respectively in first, third, six weeks on Monday, a total of 3 times) on serum ion test according to the test results, put forward

Table 1: Basic subject athlete

Name	Age	Stature/cm	Before the control of weight/kg	Target weight/kg	Train grade
Li××	27	178	69.70	68.0	Master Sportsman
Lin××	21	185	83.50	80.0	Master Sportsman
Guo×	23	175	60.50	58.0	Master Sportsman
Zheng××	21	186	75.00	74.0	Master Sportsman
Sun××	23	186	81.50	80.0	Master Sportsman
Yang×	22	193	89.50	87.0	Master Sportsman
Qian×	25	173	61.00	58.0	Master Sportsman
Zhao××	23	174	62.50	58.0	Master Sportsman
Yang×	24	180	75.50	74.0	Master Sportsman

Table 2: The process of weight control of body weight and lean body mass changes n = 9

Test time	No	Weight/kg	The body fat percentage/%	Lean body weight/kg
Before the control of heavy	9	73.91±10.52	14.52±3.51	55.68±5.22
The third week of weight control	9	72.01±10.72①	11.77±2.09①	55.58±5.74
Weight control after the end	9	70.78±10.91②	10.39±1.21①	53.78±6.31①

① Comparison before the weight control (p<.05); ②comparison before the weight control (p<0.01)

Table 3: The weight control process of athletes' sports ability index n = 9

Power/W time	Test number peak anaerobic power anaerobic power the average decline rate of anaerobic			
	Power/W	Minimum	Value /W	Decrease progressively rate
The first week 9	735.15±158.16	398.31±80.16	0.445±0.143	529.00±68.30
The third week 9	857.41±227.63	404.59±35.41	0.508±0.117	548.18±89.34
The sixth week 9	699.25±127.32	473.50±76.98	0.323±0.031	567.25±96.78

Table 4: The weight control of process indexes of athlete's humoral ion mmol/L

Time	No	Na+	Cl-	K+	Ca2+	CO2CP
The first week	9	137.52±1.01	108.18±1.75	4.69±0.21	2.29±0.05	33.71±1.36
The third week	9	145.68±1.04②	108.17±2.61	5.49±0.51	2.43±0.07①	32.21±1.18①
The sixth week	9	144.58±3.21①	108.03±1.47	4.37±0.49	2.49±0.14①	30.22±1.51①

① Comparison before weight control p(<0.05); ②comparison before weight control (p<0.01)

proposal for adjustment. Athletes sweat ion concentration mean electrolyte sports drink prepared according to equilibrium, salt, sodium lactate Ringer's solution and boiling water as raw materials, with beverage specific ion concentration: a total of 800 mL, Na+, K+, Cl-, Ca2+ ion concentrations were 58.68, 5.81, 50.52, 0.56 mmol/L.

- **The test index:** Weight monitoring physiological indicators include: body weight, skin fold thickness; exercise capacity monitoring indicators include: peak anaerobic power, anaerobic power minimum value, anaerobic power decrease progressively rate, the average decline rate of anaerobic power; hum oral ion balance monitoring indicators include: sodium ion (Na+), potassium (K+), calcium (Ca2+), chloride ion (Cl-), CO2 combining power (CO2CP).
- **Data statistics:** Data to mean ± standard deviation (x±s), using SPSS 13.0 statistics software on data obtained from a paired t test analysis.

RESULTS AND ANALYSIS

Weight control process of athlete's weight, body fat and lean body weight changes: Research process on nine subjects and athletes were three weeks weight content of the test, respectively, before the control of heavy, third weeks of weight control and weight control after the end, the results in Table 2.

As can be seen from Table 2, the third week of weight control compared with before the weight control, athlete's weight was significantly decreased (p = 0.018<0.05), the percentage of body fat was significantly decreased (p = 0.025<0.05), lean body mass has no significant decrease (p = 0.793>0.05); after weight control and before weight control compared to before, weight loss was significant (p = 0.001<0.01),

the percentage of body fat decreased significantly (p = 0.016<0.05), lean body mass decreased significantly (p = 0.028<0.05), shows that the athlete body weight is reduced in fat body weight reduction and lean body weight reduction. Weight control of third week weight loss of about weight control weight before 3.4%, fat weight loss of about 3.2%, lean body weight loss of about 0.2%, mainly to reduce the body fat, nine athletes body fat percentage in 9.7~15.0%. Weight control, weight loss of about weight control weight before 8.1%, wherein fat weight loss of about 5%, lean body weight loss of about 3.1%, 9 athletes body fat percentage in 9.5~12.5%.

Control process of athletes' sports ability index changes: On exercise ability of athletes in the testing process, respectively, in experiment first, third and sixth weeks on peak anaerobic power, anaerobic power minimum value, the average of anaerobic power and anaerobic power decline rate was tested, the results in Table 3.

Table 3 shows, third athletes and first weeks compared, peak anaerobic power, anaerobic power minimum value, the average of anaerobic power and anaerobic power decline rate are higher and have no significant difference (p>0.05). Sixth weeks and first weeks compared, peak anaerobic power decreased slightly, but anaerobic power minimum average rise, anaerobic power, anaerobic power decline rate decreased, indicating anaerobic ability continuously is better, have no significant difference (p>0.05).

Weight control progress athletes humoral ion index changes: In the course of the study, in first, third and sixth weeks on nine subjects and athletes sweat component of the monitoring, the results in Table 4.

Table 4 shows that third weeks and first weeks compared to athletes, Na+ increased significantly

($p < 0.01$), after adjustment, in sixth weeks when they fall back. Cl^- , K^+ decreased slightly, have no significant difference ($p > 0.05$), Ca^{2+} increased gradually, third weeks, sixth weeks and first weeks in both increased significantly ($p < 0.05$). The CO_2CP values at first weeks than normal limits, that athletes in vivo alkaline reserve volume is higher, CO_2CP decreased gradually, of which sixth and first weeks, CO_2CP decreased ($p = 0.002 < 0.01$), but still were higher than the normal limits.

Pre-competition weight control during anaerobic exercise capacity monitoring: From energy consumption and sports ability, Ricardo Silvestre study found that athletes' body fat and maximal oxygen uptake into negative correlation ($r = -0.67$) (Silvestre *et al.*, 2006), further research has also pointed out, body fat and aerobic capacity and anaerobic capacity were negatively related (Science and Technology Report, 1982). Lean body mass in addition with the human anaerobic and aerobic capacity was highly correlated (Binghong and Enli, 2006), vertical jump ability etc have significant correlation. Taekwondo is the explosive force, sensitive quality requirements of high project, also requires good anaerobic energy supply capacity and good oxygen removal ability of lactic acid. If the player's excess body fat, will affect the game in VO_2 , decreased lactate clearance capacity, at the same time, reduced exercise capacity, affect the play of the game. Therefore, in order to scientific and reasonable arrangement of the training and maintain the best athletic ability, for weight loss in athletes, maximum muscle strength and weight ratio is crucial to weight loss, namely the maximum reduction of body fat and increase muscle strength. However, different weight loss method the lower fat weight effect is different. Taekwondo sports require athletes to have good speed quality, strength and endurance. Within a short time of muscular force mainly rely on the ATP-CP system for energy, while in the 6 min competition for athletes capability have higher requirements, so the more use of 30s Wingate anaerobic tests to assess the Tae Kwon Do anaerobic exercise capacity. From the results in Table three visible, anaerobic power peak increases at first and then decreased slightly phenomenon, with members of the body fat rate and lean body weight change analysis, third weeks when the test players weight control to reduce fat weight, this team exercise capacity lossless even slightly improved, showing a "small machine, big power" the phenomenon of. By sixth weeks, the part of the players by consumption of fat is difficult to reach the target weight, the sacrifice of part of lean body mass, the players' ability to a certain extent affected. But from the overall peak anaerobic power, anaerobic power average value is stable, in the prename high-intensity training at the same time slow weight control and in line with the electrolyte beverage

supplement, can make the players' anaerobic exercise capacity to maintain good.

Appropriate to increase the amount of exercise, pay attention to organize activities: Increasing the amount of exercise more generally used slow weight reduction process, it is to reduce body fat, weight control the most desirable and effective method. Taekwondo for both anaerobic and aerobic exercise, the Taekwondo training and weight control has certain complexity. In weight control practices, lengthen athlete training after finishing activities to reduce the training time after lactic acid, reduce the conversion of lactate to fat ratio and increase of small and medium intensity aerobic exercise, promoting fat decomposition. Extensive research has demonstrated that aerobic exercise can directly influence the energy balance, or by adjusting the endocrine metabolism (primarily insulin metabolism) to increase energy expenditure, or through the regulation to improve the enzyme activity, so as to promote the hydrolysis of fat in addition, Taekwondo athletes in pre-competition training, resistance muscle strength training is essential to. Resistance muscle strength training can stimulate the system, promote muscle protein synthesis and improve the body's basal metabolic rate, to maintain lean body weight and body weight control in a certain role. Kraemer *et al.* (1999) on weight control in the process of exercise on weight control exercise capacity after impact, the results showed, compared with simple dietary restrictions, in slow weight control during moderate combination of diet and aerobic exercise and resistance exercise, to more effectively maintain the machine body muscle strength and maximum oxygen content.

Pre-competition weight control during body environment monitoring and effect:

- **Serum sodium and chloride ion changes:** In order to guarantee the high intensity training athletes during homeostasis, avoid in vivo ion balance disorders affecting the body health and athletic ability, we study the preparation containing sodium chloride, potassium chloride and calcium chloride sports drink and when added during exercise with sweat secretion and loss of electrolytes. From this study we can know that, athletes after 6 weeks of slow controlled heavy and large intensity training, training every day with the drinking of the designed sports drinks, serum sodium concentration in weight control for third weeks increased significantly and some members of the sodium ion concentration is slightly higher than that of the normal range (the upper limit value of serum sodium ion concentration in normal range: 135~145 mmol/L) is a possible cause: the individual athlete eating salty and we made sports drinks using mixed

solution of sodium lactate Ringer's injection, the higher concentration of sodium chloride. We suggested that the canteen and communication of salt in the diet is reduced and sports drinks in sodium chloride content of trace down, after adjustment for sixth weeks, weight control of athletes' serum sodium ion concentration decreased to the normal range. Supplementation in exercise suitable concentration of sodium electrolyte liquid (concentration of 20~30 mmol/L), which can effectively prevent the decrease in the volume of circulating blood and dehydration, Del Coso study also shows that, compared with not drinking any liquid, electrolyte liquid can be different levels keep drinking after exercise the leg muscle strength if drink sports drink on sodium ion concentration is low (10 mmol/L), leg muscle strength may be relatively poor. Chloride and sodium ions are mainly present in the extra cellular fluid, for the maintenance of extra cellular fluid osmolality and capacity, maintain neuromuscular excitability, regulating acid-base balance of the body plays an important role in. From the results of the present study shows that, after 6 weeks of slow controlled heavy and large intensity training, training every day with the drinking of the designed sports drinks, athletes' serum chloride concentrations remained stable, but the 3 test values were within normal limits or slightly above the normal range (the upper limit value of serum concentration of chloride ion the normal range of 98~107 mmol/L), the main reason may be the diet and sports drinks intake more, suggested that the sports beverage compounding should avoid high sodium chloride. The changes of serum chloride and sodium ions are different variation tendencies of Taekwondo, likely due to anaerobic energy supply characteristics of athletes, quiet state body NaHCO_3 content increased adaptability, serum sodium and chloride ions changes change presents inconsistency. Exercise training in general with sodium chloride in the form of added sodium ions and chloride ions, exercise should be supplemented with mass fraction of 0.5%~0.7% low isotonic sodium chloride solution. Avoid high concentrations of salt solution that exercise training in high osmotic pressure of plasma, intracellular to extra cellular water transfer, resulting in cell loss, affect cell metabolism, resulting in decreased exercise capacity.

- **Serum potassium and calcium ion changes:** High temperature environment exercise training will make the sweat of potassium loss increase; every body of potassium loss can even reach 6g. Long time and large amount of exercise training, with the sweat and urine potassium secretion can cause total body potassium deficiency. Potassium deficiency may cause abnormal ECG, impact energy supply.

Some scholars study shows that, from the beginning of the sport to sport after the end of the 24h, interstitial calcium, sarcoplasmic calcium and mitochondrial calcium in quite a long period of time is synchronous rising trend, a description of the motion of the in vivo mobilization of calcium in large quantities. During high intensity exercise, in the sweat calcium ion can reach 5mmol/L and the body of free calcium metabolic pool of only 4~7g calcium, if do not try to take seriously, in vivo calcium easily lost. The optimum concentration of serum potassium and calcium ions to maintain normal neuromuscular excitability has important effect, low blood potassium may reduce muscle contractility, hypocalcaemia may cause muscle spasm. And myocardial cells on serum calcium dependent than skeletal muscle on serum calcium ion is more dependent, because myocardial contraction of mainly relying on the extra cellular fluid calcium ions across the membrane into the cell cytoplasm and skeletal muscle contraction when needed most by the sarcoplasmic reticulum calcium release to fine in the cytoplasm. In the past control surveillance study, had players with great intensity training sweat a lot loss more ion without timely supplement, causing the body potassium or calcium deficiency, leading to decreased muscle strength, muscle cramps and so on. In this study, athletes after 6 weeks of slow controlled heavy and large intensity training, daily training increased potassium ion, calcium ion motion beverage supplement. The results showed, slow weight control during potassium values were in the normal range to maintain stability, calcium rises gradually, at sixth weeks, the plasma concentration of calcium ions and first weeks compared to rise significantly, but were still within the normal range, through sports drink supplementation, the body can keep a sufficient ionic reserve, to maintain the stability of the environment, but also to maintain good athletic ability (such as muscle strength) provides a basis.

- **Plasma carbon dioxide combining force variation:** In the plasma bicarbonate buffer system, is the most content of alkaline substances, to a certain extent, can represent the plasma buffering capacity, it is customary to every 100 mL plasma containing bicarbonate called alkali reserve. Clinical determination of HCO_3^- content, often based on combination in which carbon dioxide volume (mL) to calculate, namely in the standard condition (partial pressure of carbon dioxide of about 40 mmHg per 100 mL), the plasma being in the form of HCO_3^- -carbon dioxide quality to express, known as the two carbon monoxide binding force. As a result of Taekwondo Athletes' long-term anaerobic sport training, the in vivo alkaline reserve will adaptively increased, the

results in this study can be seen in athletes, weight control and CO₂ combining power is higher than normal limits, only in the sixth week some athletes alkali reserve volume decreased significantly, which reflects the pre-competition training strength increases, resulting in greater consumption of alkali reserve, the next morning was not completely restored.

CONCLUSION AND SUGGESTIONS

Conclusion:

- After six weeks of weight control, all nine subjects and athletes were highly significant changes in weight.
- Weight control from the beginning of the third week, athlete's body weight and body fat content began to drop dramatically. 3.1.3 after 6 week weight control, through the test showed the percentage of body fat and lean body mass were significantly decreased.
- Athletes' anaerobic exercise capacity in the whole weight control period was not changed significantly, from the beginning of the third week athletes sweat sodium and calcium ion concentration increased significantly, while carbon dioxide binding force is greatly reduced, until the end of sixth week weight control.

Suggestions:

- By the appropriate increase in relaxation time and increase training of aerobic training proportion, can

realize the athletes in weight control process to consume fat mainly target. It can effectively ensure the athletes in anaerobic capacity without loss or damage is smaller, maintaining the original aerobic exercise ability.

- Through the deployment of electrolyte drink supplementation in athletes during weight loss during fluid ion, maintain a team environment in the relatively stable.

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